

## Commercial Fishery in Lake Erie: Coping with Change

Rob MacGregor  
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Lake Erie Management Unit

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## BACKGROUND AND RELEVANCE TO PRIORITIES

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### Ecosystem Challenges

- 13 million people in basin
- Careless development, substantial degradation of ecosystem

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### Stresses on Fish Communities

- Overexploitation
- Degraded tributaries, dams
- Alteration, destruction of fish habitat
- Toxic loadings, fish flesh advisories (closure of walleye fishery 1970-73)
- Loss of burrowing mayflies
- Substantial loss of wetlands, spawning and nursery habitat
- Nutrient enrichment, Cladophora, oxygen depletion
- Exotic species:
  - lamprey, carp, smelt, white perch, alewife, Bythotrephes, zebra and quagga mussels, gobies

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## Past Fish Community Responses

- Successive depression/collapse/loss of native species:
  - lake trout, lake sturgeon, lake herring, whitefish, sauger, blue pike (extinct), walleye
- All native terminal predators lost or severely reduced by 1970s
- Most large native planktivores and bentivores lost or reduced
- Explosive and pervasive invasion of exotic species
  - small, short-lived planktivores
  - astatic, unpredictable fish community

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## Changes in the 1980s and 1990s

- Ecosystem, unstable and unpredictable
- Phosphorus controls
  - control algal production
- Zebra and quagga mussel invasion
- Oligotrophication in all basins
  - high transparencies, lower productivity
- Change, loss of habitat
  - transparency/walleye habitat?
- Increased abundance of predators
  - walleye resurgence
  - high lake trout biomass
  - burbot increase
- Resurgence of whitefish, lake sturgeon
- Increase in smallmouth bass and muskellunge
- Strong declines in:
  - white perch, y. perch, smelt
- Shifts in distribution
  - walleye deeper, smelt increase in C. Basin
- Decreased abundance and growth of walleye
- Declining growth and condition of smelt
- Declining recruitment of yellow perch
- Unknown effects of recent exotics
  - gobies, Bythotrephes, Ceratopagis
  - river ruffe?

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## Changes Most Pronounced in East Basin

- Approaching ultra-oligotrophic conditions
- Loss of Diporeia
- Vastly reduced yellow perch abundance
- Strong declines in smelt abundance, growth, condition
- Reduced eastward migration of western walleye stocks
- Rainbow trout, smallmouth bass up
- Whitefish and burbot more abundant
- Total harvest down by 77%; 59% reduction in landed value

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## General Questions

- Extent of oligotrophication, effects on fish production and fish community structure?
- Role of zebra and quagga mussels, role of phosphorus controls?
- How much further will oligotrophication progress? East Central Basin issues?
- Relative role of top-down, bottom-up effects?
- Future of percids in Lake Erie?

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## Management Changes

- Gill net bans in all states
- Restrictions on sale of walleye harvested from U.S. waters
- 1984 implementation of quota management in Ontario
- Gillnet mesh size restrictions in Ontario
- Size restrictions in U.S
- Season closures (e.g., Ontario restrictions on spring harvest of yellow perch since 1995)
- Ontario cap on E. Basin smelt harvest
- Reductions in lake Trout stocking
- Ontario royalties
- New Business Relationship with OCFA
  - royalty administration, compliance monitoring, supplemental assessment, data entry and data management agreements
- Code of Conduct for Responsible Fishing Practices
- Directed enforcement approach

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## Contaminant and Human Health Issues

- Contaminants have caused past disruptions
  - closure of walleye fishery in early 70s
- Presently only one restriction in Ontario for commercial fishery (large channel catfish)
- Zebra mussel effects and apparent shift to benthically driven system may alter contaminant pathways
  - potential effects on fish flesh, human health and market for Lake Erie fish?
- Ontario changes in sport fish advisories; differing contaminant advisories among agencies and jurisdictions?

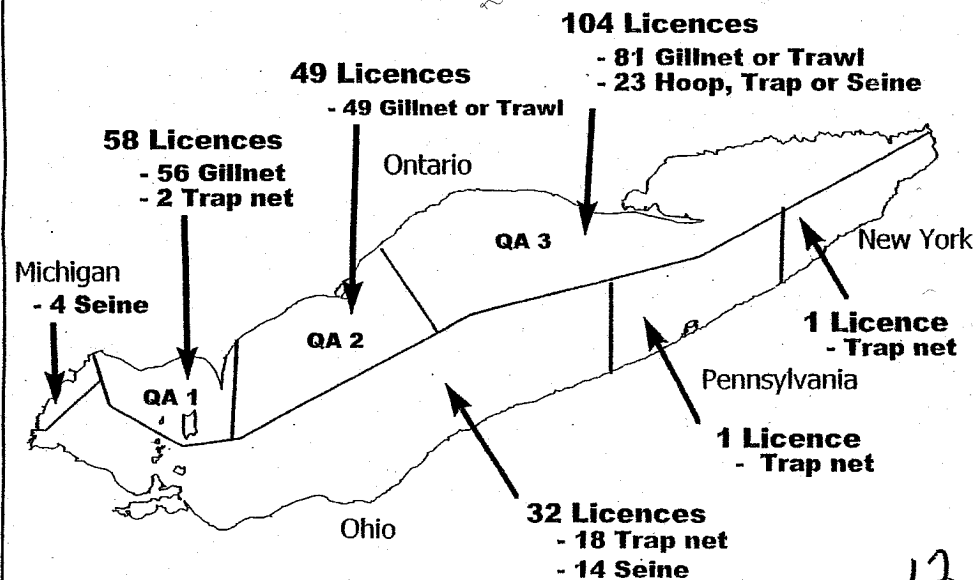
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## Responses by Commercial Fishery

- Regulation changes have lead to vast reductions in US commercial harvests
- Forced to learn, respond, adapt quickly to ecosystem changes:
  - take advantage of abundant species (smelt, white perch)
  - new technologies (selective square mesh trawl for whitefish, major trawl fishery for smelt)
- Develop new markets:
  - Japanese market for smelt
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- Develop innovative markets
  - live capture and transport to fish-out ponds, ethnic markets
- Change price structure in accordance with supply

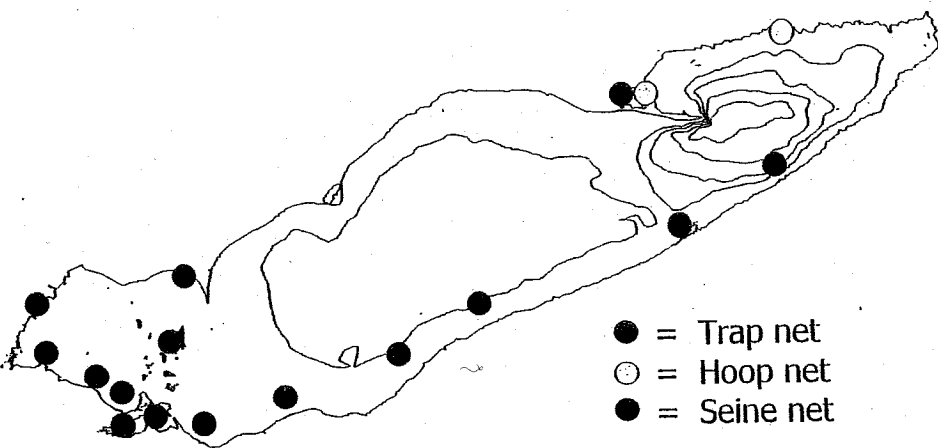
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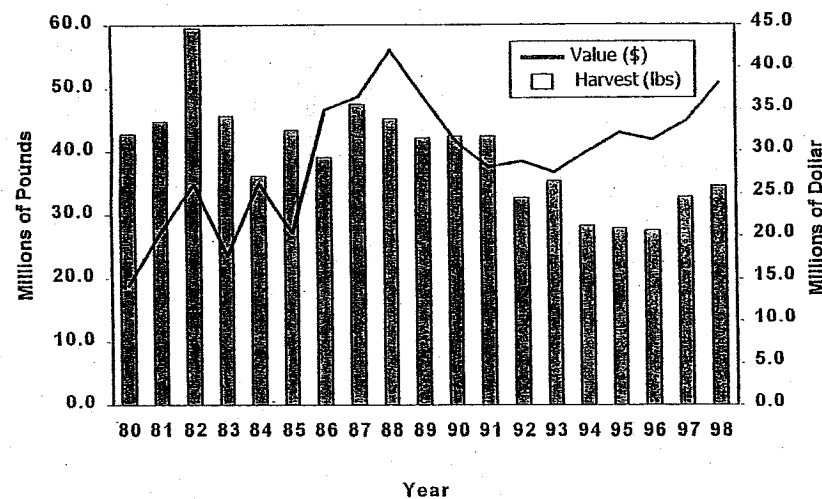
# Location of Seine, Trap Net, and Hoop Net Fisheries on Lake Erie, 1998



Markers indicate general location only and don't represent overall abundance

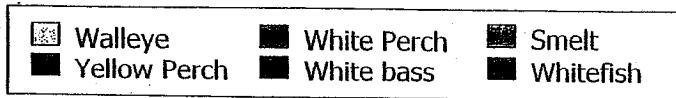
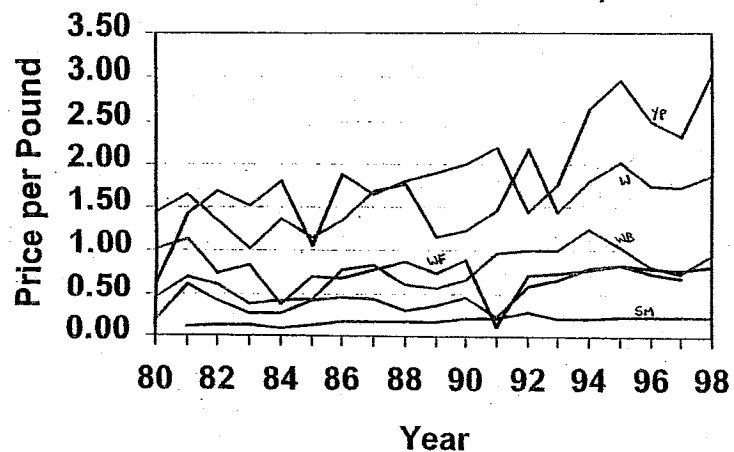
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# Lake-Wide Annual Landed Weight and Landed Value of Canadian Commercial Fishery



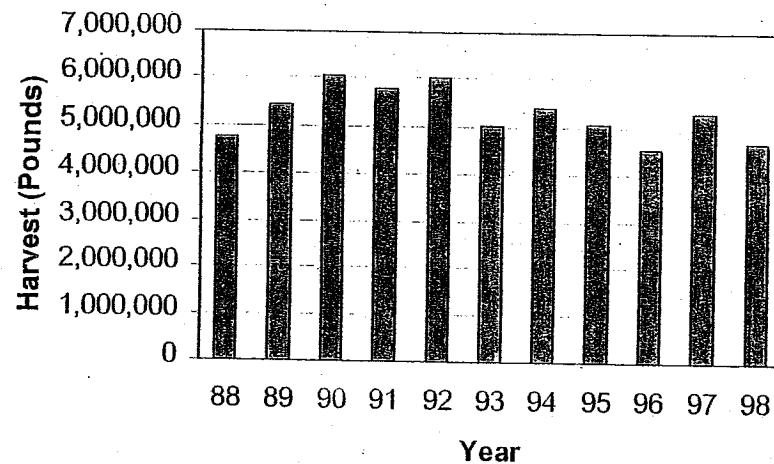
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# Price per Pound - Landed Value Canadian Commercial Fishery



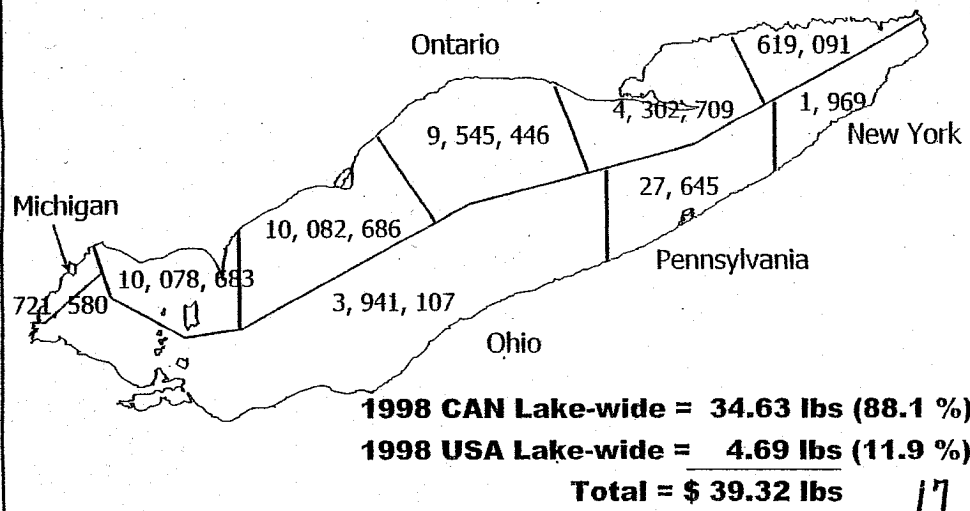
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# United States 1988-98 Commercial Harvest (lbs) NY, MI, OH, PE Combined

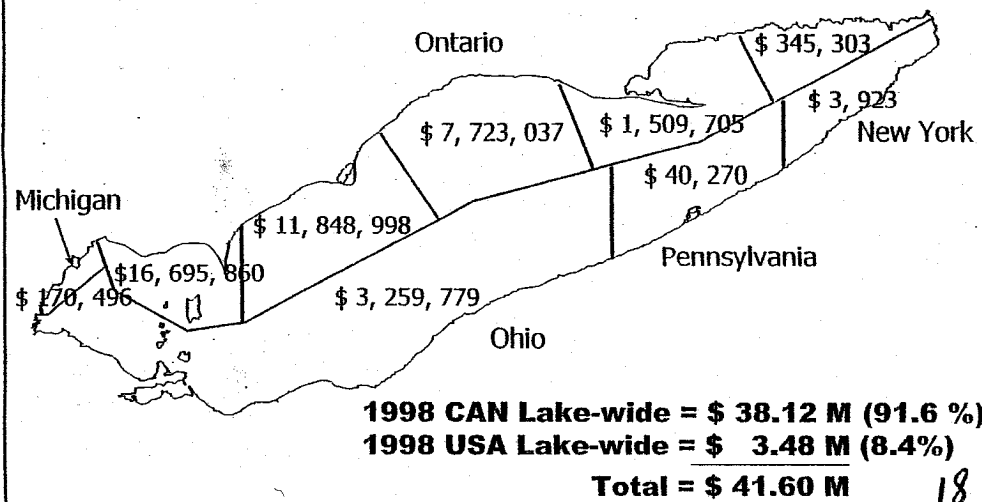


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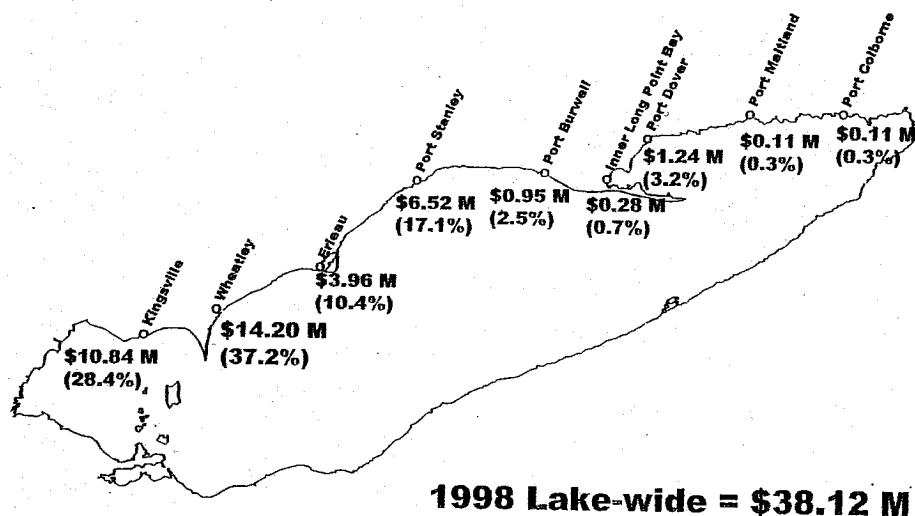
1998 Landed Weight (in lbs) of Lake Erie's Commercial Fishery by Jurisdiction and Statistical Area, All Species and Gear Combined



1998 Landed Value (in Canadian dollars) of Lake Erie's Commercial Fishery by Jurisdiction and Statistical Area, All Species and Gear Combined



1998 Landed Value of Canadian Commercial Fishery by Port, All Species

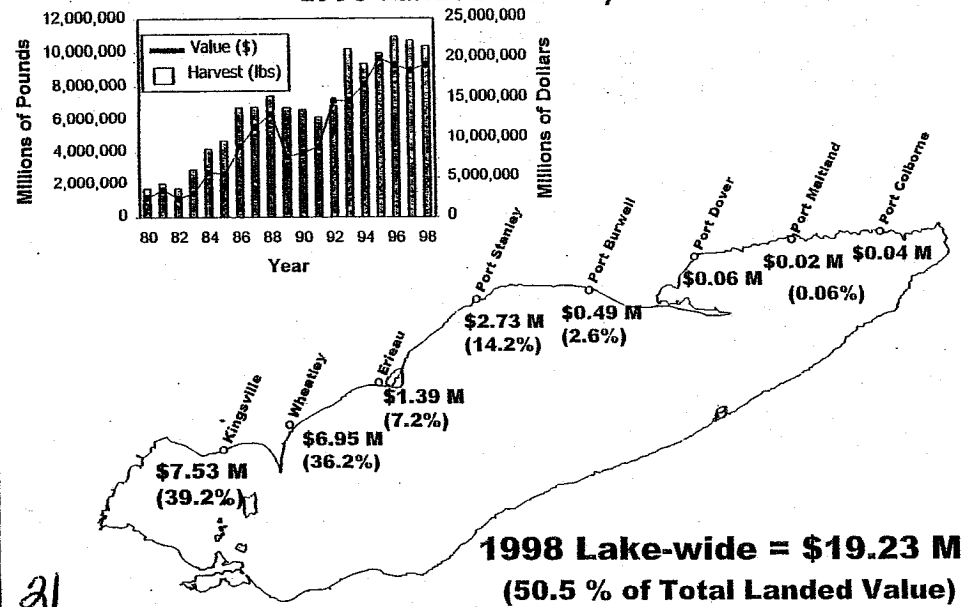


Top 5 Commercially Harvested Species in 1998, by Country

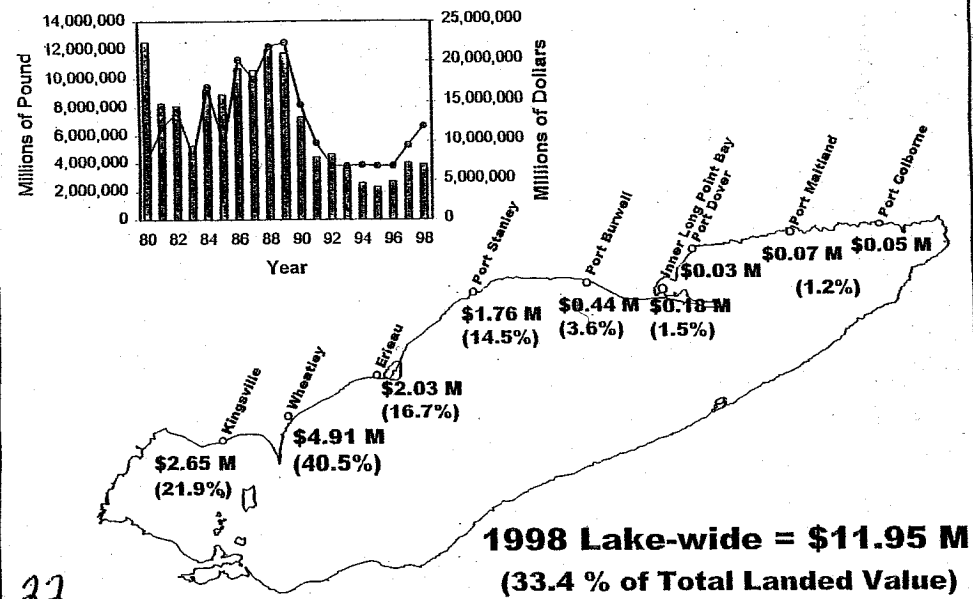
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Buffalo	311,625	6.6
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Total '98 Harvest	4,690,564	

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Walleye	10,332,228	29.8
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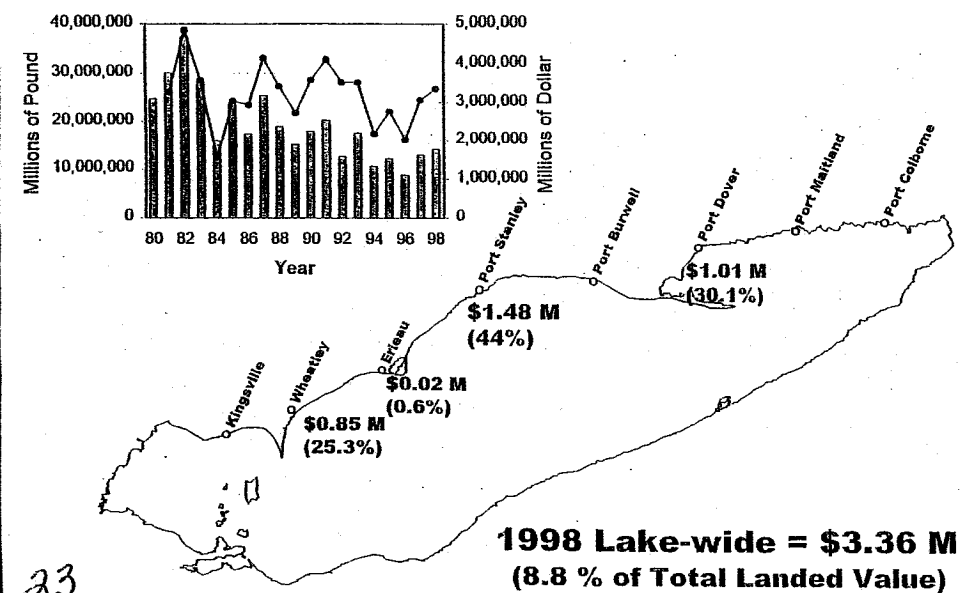
## Canadian Commerical Walleye Harvest Trend and 1998 Landed Value by Port



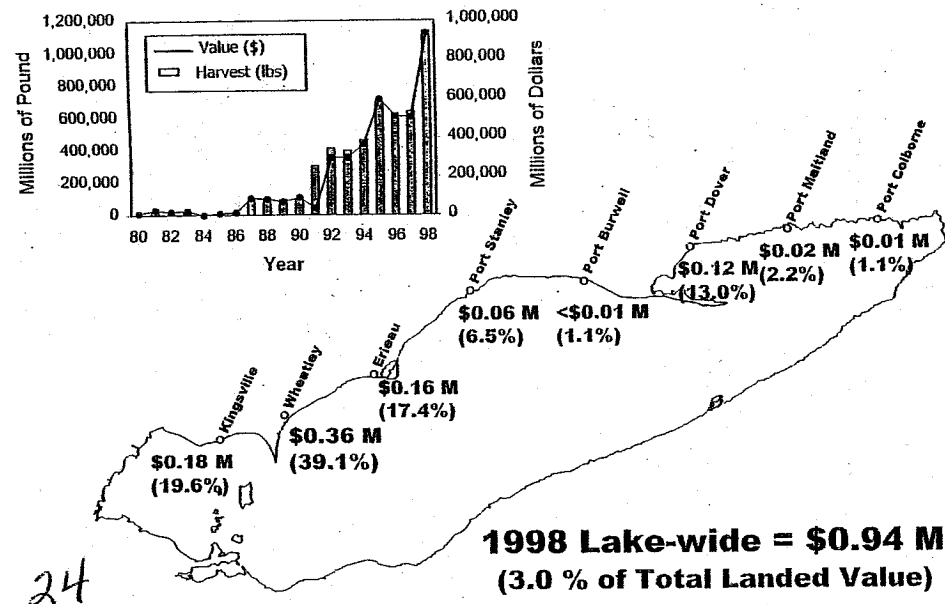
## Canadian Commerical Yellow Perch Harvest Trend and 1998 Landed Value by Port



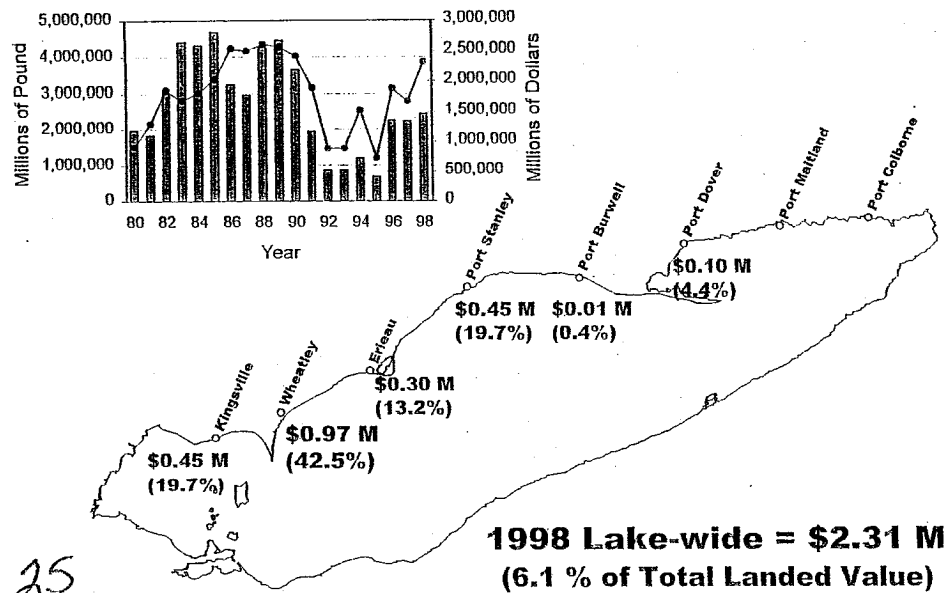
## Canadian Commerical Rainbow Smelt Harvest Trend and 1998 Landed Value by Port



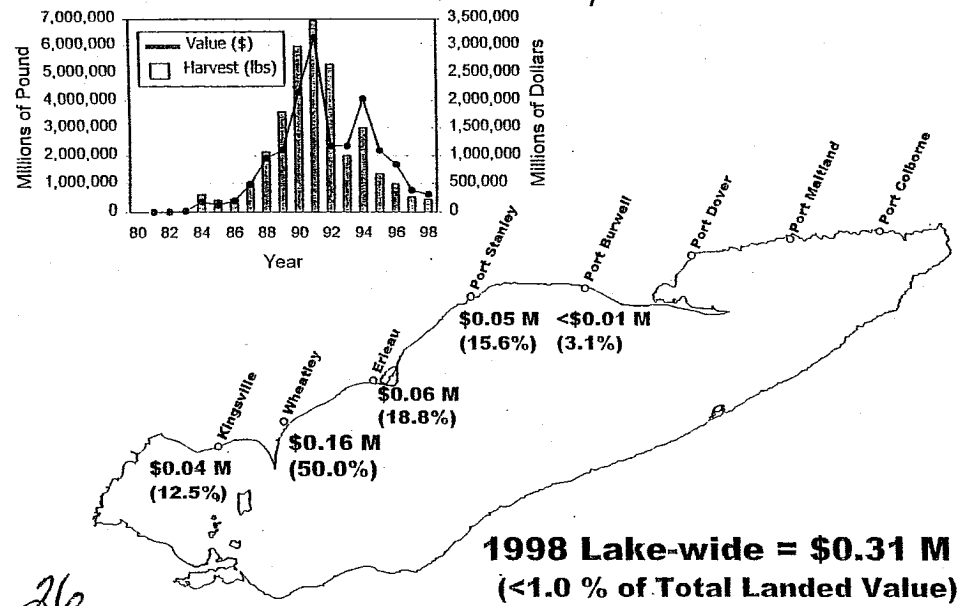
## Canadian Commerical Whitefish Harvest Trend and 1998 Landed Value by Port



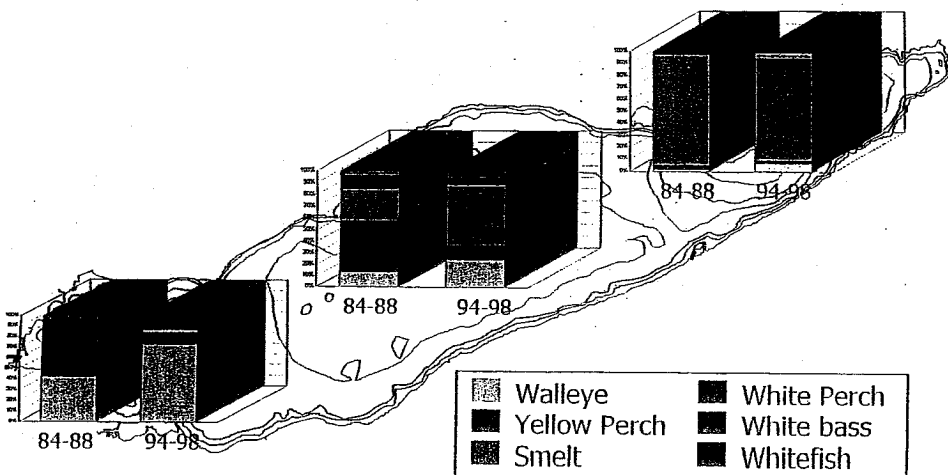
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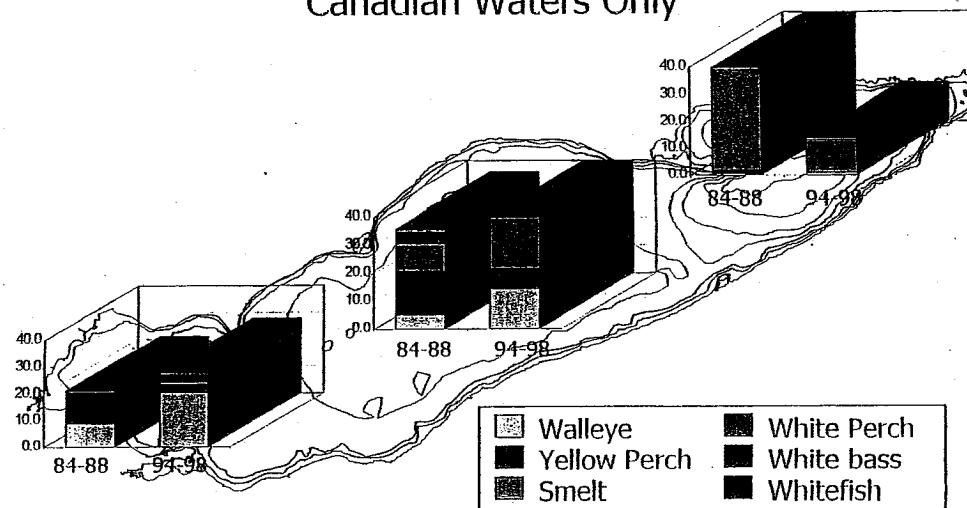
## Canadian Commerical White Perch Harvest Trend and 1998 Landed Value by Port



## Percent of Basin Harvest (lbs) by Species, 1984-88 (pre-zebra) and 1994-98 Averages Canadian Waters Only



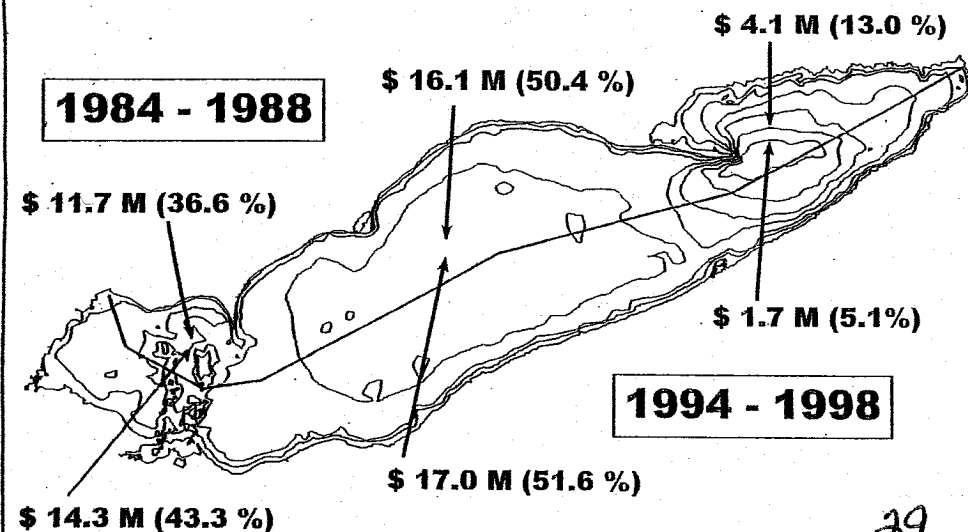
## Percent of Lake-wide Harvest (lbs) by Species and Basin, 1984-88 and 1994-98 Averages Canadian Waters Only



Total Average Landed Value of Commercial Fishery by  
Basin for the Periods of 1984-88 and 1994-98  
Canadian Waters Only

**1984 - 1988**

**1994 - 1998**



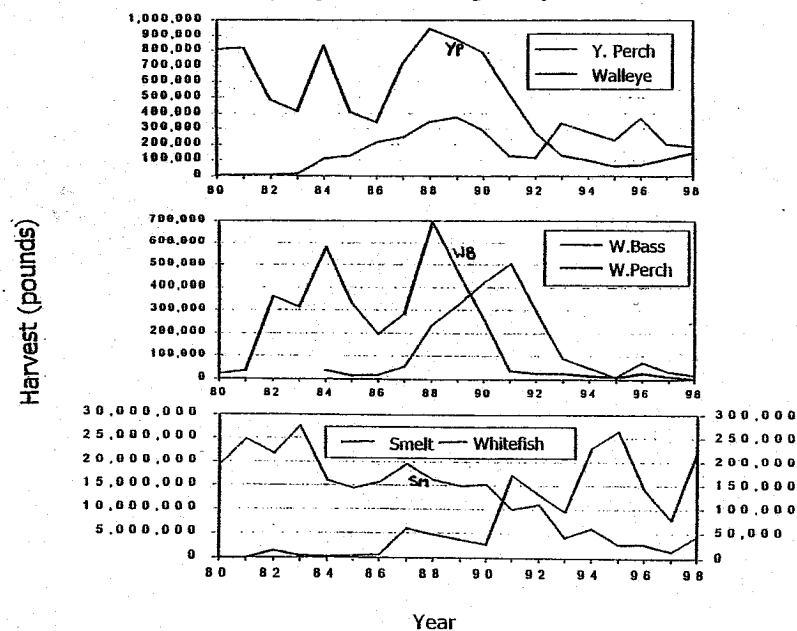
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Five Year Averages for the Lake-wide Commercial  
Landed Weight (lbs) by Species,  
Canadian Waters Only

Species	Pre-Zebra		% Change
	1984-88	1994-98	
Walleye	5,956,000	10,239,000	71.9
Yellow Perch	10,310,000	3,136,000	-69.6
Smelt	20,412,000	11,740,000	-42.5
Whitefish	45,800	717,000	1465.5
White Bass	3,891,000	1,773,000	-54.4
White Perch	938,000	1,270,000	35.4
Total Avg. Landing	41,554,000	28,876,000	-30.5
Total Avg. \$ Value	32.0 M	33.1 M	3.4

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Trend in Harvest (lbs) of the Major Species in the East Basin



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Five Year Averages for the East Basin Commercial  
Landed Weight (lbs) by Species,  
Canadian Waters Only

Species	Pre-Zebra		% Change
	1984-1988	1994-98	
Walleye	208,840	254,224	21.7
Yellow Perch	650,752	98,388	-84.9
Smelt	16,350,487	3,492,222	-78.6
Whitefish	23,439	186,770	696.8
White Bass	418,851	29,558	-92.9
White Perch	70,793	18,899	-73.3
Total Avg. Landing	17,723,161	4,080,062	-77.0
Total Avg. \$ Value	4.14 M	1.70 M	-58.8

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## INDUSTRY ISSUES AND CONCERNS



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## Industry Today

- Largest freshwater commercial fishery in the world
  - despite major and on-going changes in fish community and ecosystem

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## American Commercial Fishery

- Major gear restrictions and restrictions on the sale of some highly valued species have substantially reduced U.S. contribution to lakewide commercial harvest
- Commercial operations now restricted to live capture gear
- Approximately 38 active licenses in U.S. comprised of seine and trapnet fisheries
- 12 % of lakewide harvest (lbs) and 8.4% of landed value in 1998

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## Ontario Commercial Fishery

- Very important to provincial economy
  - particularly to local communities along the lake
- 38 million dollars landed value in 1998
  - 92% of walleye and yellow perch exported
  - 99% of rainbow smelt exported
  - generates new dollars for province
- Employs approximately 1800 people
- 213 active licenses:
  - 188 gill net and/or trawl (~80 vessels)
  - 25 live capture (seines, hoop nets and trap nets)
- Approximately 11 processing plants
- Expanded value of industry estimated by OCFA to approach \$400 million dollars

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## Canadian Commercial Industry Concerns

- **Rapid changes in fish community and ecosystem**
  - large investment in specific technologies
- **Major investments in Lake Erie percids**
  - harvest technologies, processing and marketing
- **Yellow perch and walleye make up 84% of total value**
  - 70% reduction in perch harvest since '80-84
- **Walleye harvests have increased by 72%**
  - reduced growth, abundance a big concern
- **Major investments in trawl fishery for smelt**
  - 42% reduction in harvest
- **Concern over effects of exotic species**
  - want regulations with teeth
- **Declining ability of management agencies to sustain longterm assessment programs**
  - implications to resource allocation decisions
  - particularly NB in rapidly changing ecosystem and fish community
- **Declining research capability at lower trophic levels**
- **Want fisheries management based on good science**
  - not on best guesses
- **Concerned that fisheries managers may be forced to take "easy way out" and simply follow the system**
  - fisheries vs water quality objectives
  - needs of all interests must be balanced

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## Industry Concerns (cont'd)

- Concerned that water quality agencies may not be considering fish community structure and production
  - need to ensure productive harvests of highly valued percids
- Concerned that agency efforts to introduce exotic salmonids and restore some native species may negatively influence commercial fishery
- Concerned over major declines and shifts in fish community in east basin
  - loss of large portion of Lake Erie as a major contributor to industry
  - major implications to economies of local communities of east basin
- Concerned that harvest estimates (principally sport fish) are not rigorous and question their accuracy
  - implications to commercial allocations and TACs
- Want effective controls and monitoring on all resource use (commercial, sport and baitfish extraction)
- Concerned over apparent declines in abundance, distribution and species composition of forage base

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## RESEARCH AND SCIENCE PRIORITIES

### Ecosystem and Fish Community

- Relationship of lower trophic levels and water quality parameters to fish production, fish community structure and composition
- Food-web dynamics and influence on key commercial species
- Improved fish community and ecosystem approaches to fisheries management
- Develop means of achieving FCGO's
- Improved understanding of ecosystem, fish community and stock dynamics
- Restoration of optimal ecosystem for percids
- Improved understanding and management of forage base based on strong science

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## Habitat

- Determine optimum habitat requirements for major commercial species (esp. percids)
- Develop and test methods to return optimal environmental conditions for percids
- Identification of critical habitats for key commercial fish species
  - implement strong habitat improvement and protection strategies

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## Restoration

- Restoration of native fish species
  - understand implications to production of highly valued commercial species
  - assess harvest potential
- Restoration of healthy, productive fisheries in east basin based on highly valued species
- Restore critical habitats for highly valued species
- Develop specific fish community and ecosystem approaches to rehabilitation and protection of key commercial species

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## Assessment and Harvest Management

- Improve methods of estimating abundance and safe harvest levels
  - based on ecosystem and fish community approach and strong science
- Determination of minimum stock sizes for spawning and recruitment success
- Development of management and harvest strategies based on stock dynamics
- Improved indicators and forecasting techniques
  - effects of environmental change on abundance indices
- Improved estimates of natural and fishing mortalities
- Factors affecting production, survival, mortality and recruitment of key commercial species
- Improved harvest estimates by all resource users
- Development and protection of longterm assessment and research programs at all trophic levels
  - aimed at ensuring longterm sustainable fisheries of highly valued species
  - based on sound scientific principles

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## Exotic Species

- Improved understanding of the effects of exotic species invasions on dynamics of key commercial fish species
- Improved biological, technological and management techniques to prevent/manage exotic species
- Identify optimum fish community resilient to exotic species invasions

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### Fish Stock Dynamics

- Identify discrete stocks of key commercial fish species and their present/potential importance to sustainable, productive fisheries
- Develop stock protection and enhancement strategies based on sound science
- Develop harvest management strategies with due regard for stock concept

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### COMMERCIAL FISHERY

#### Next 5 Years

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### 5-Year Projection

- Industry relies heavily on yellow perch, walleye and smelt
- Further declines in yellow perch and walleye will jeopardize industry viability
- Will continue to explore opportunities for marketing other species
- Whitefish up and coming
- Demanding improved science and assessment aimed at ensuring longterm sustainability and productivity of highly valued species (esp. y. perch, walleye)
- Needs lead-time to adapt and develop new markets, adapt technologies - wants improved forecasting
- Restoration of highly valued species in east basin fish community

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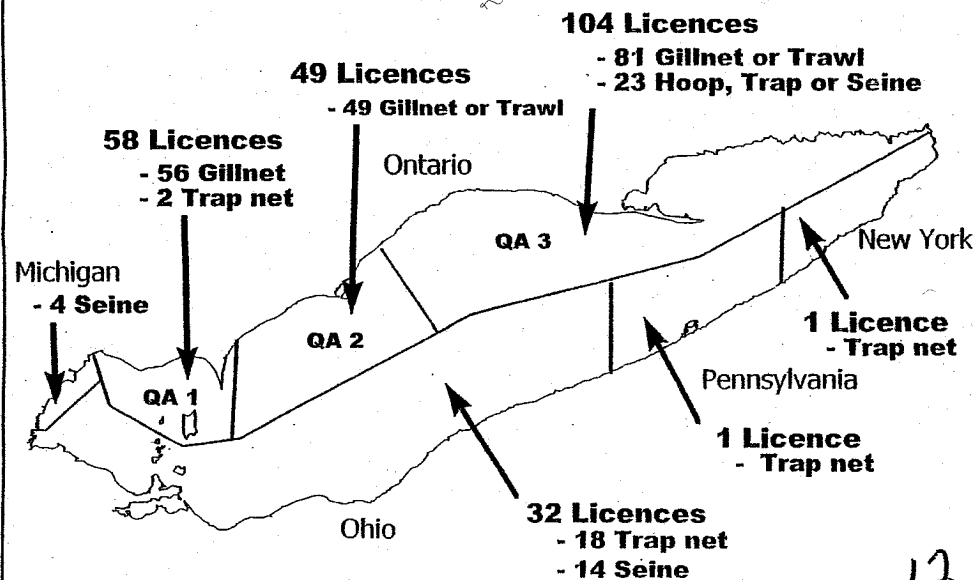
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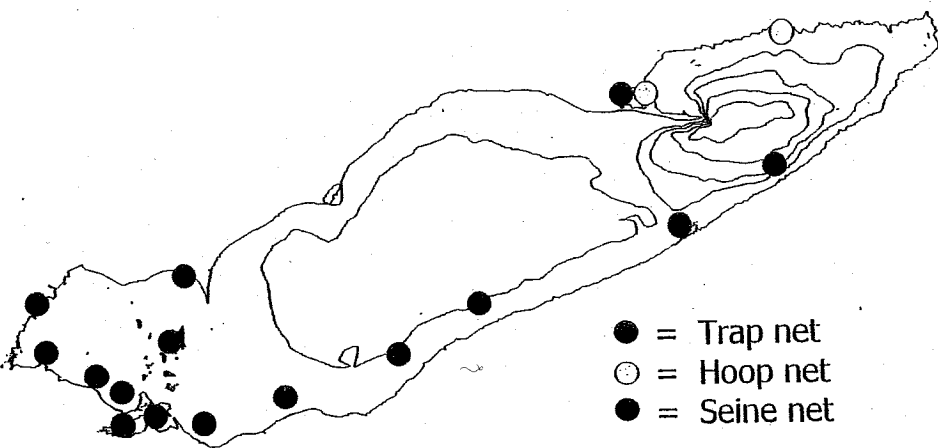
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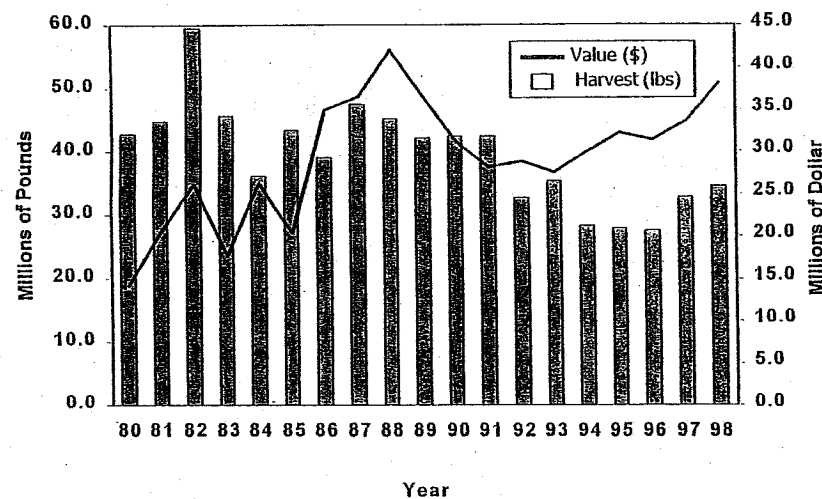
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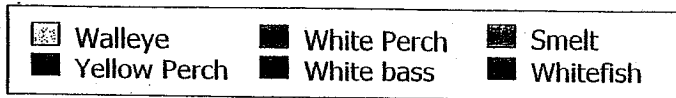
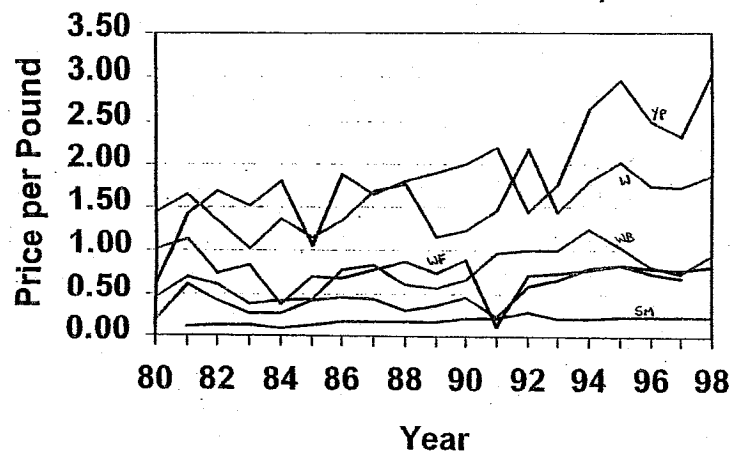
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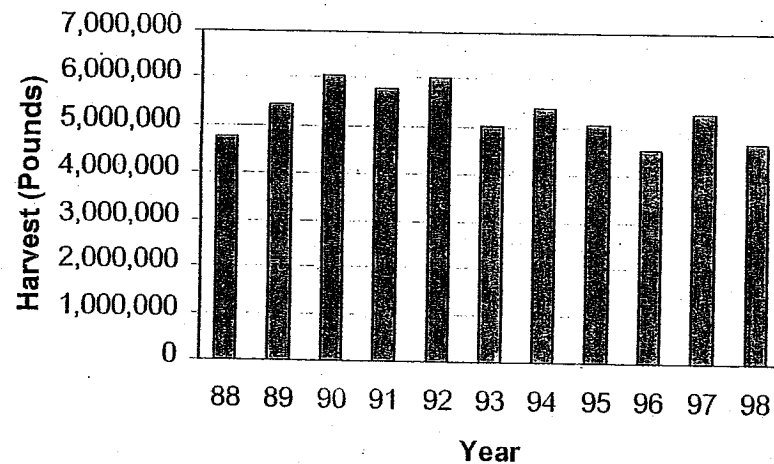
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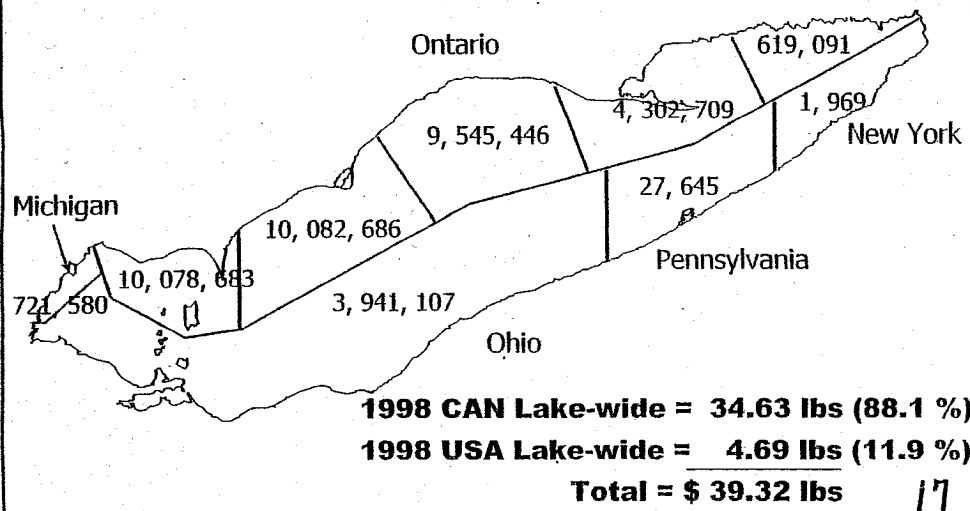
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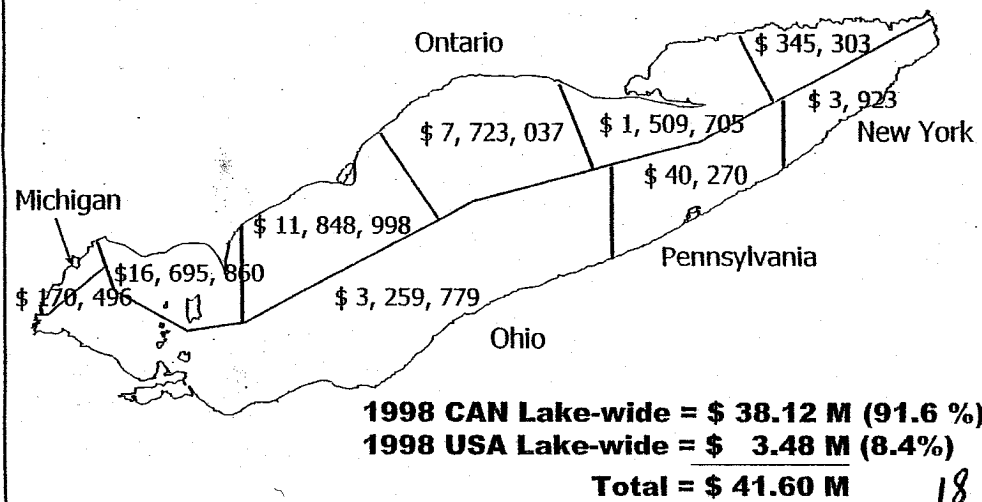


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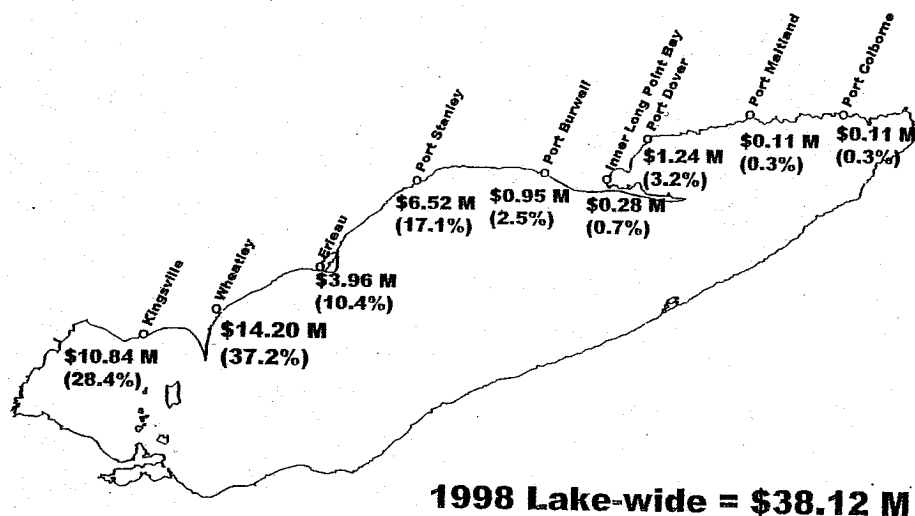
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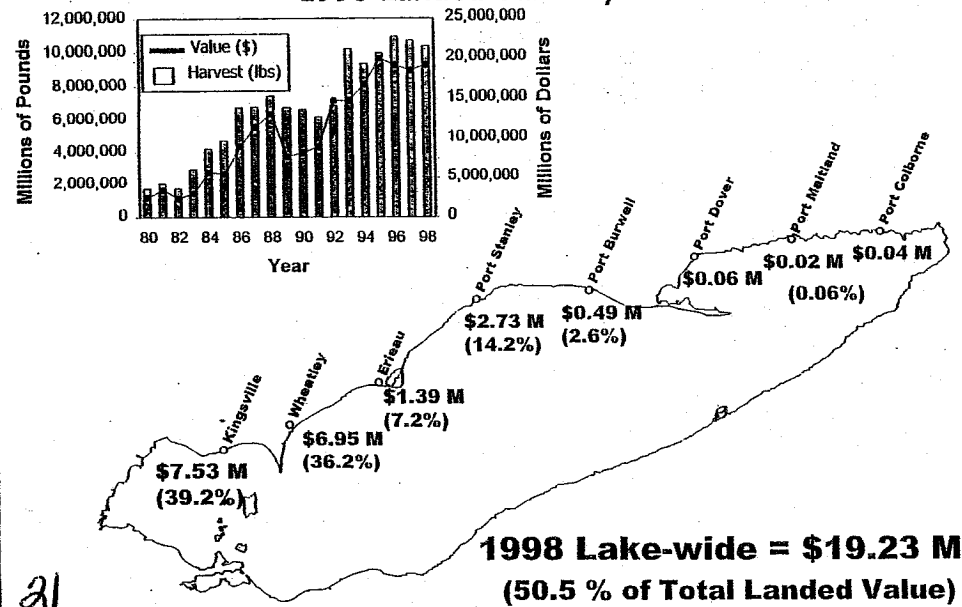


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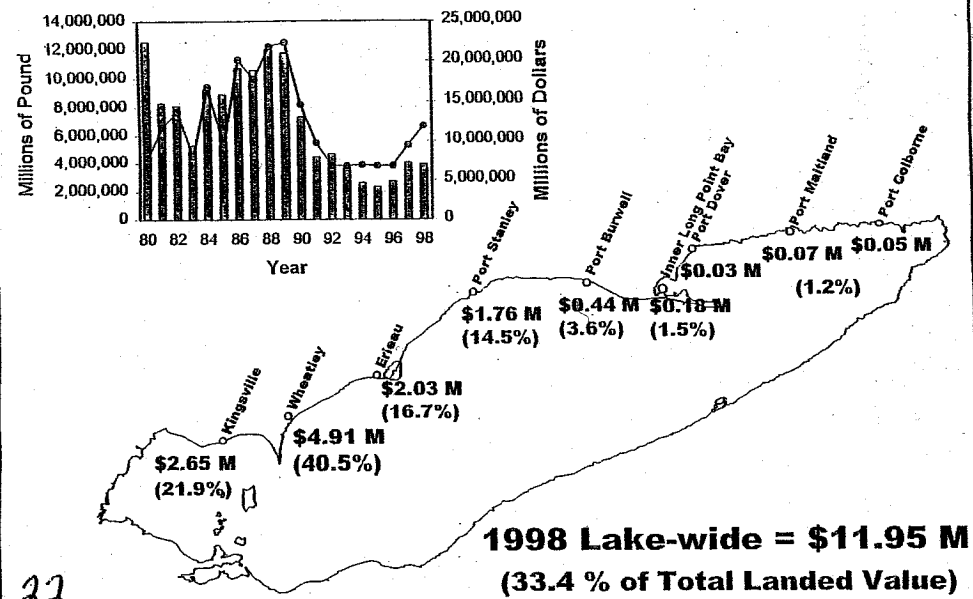
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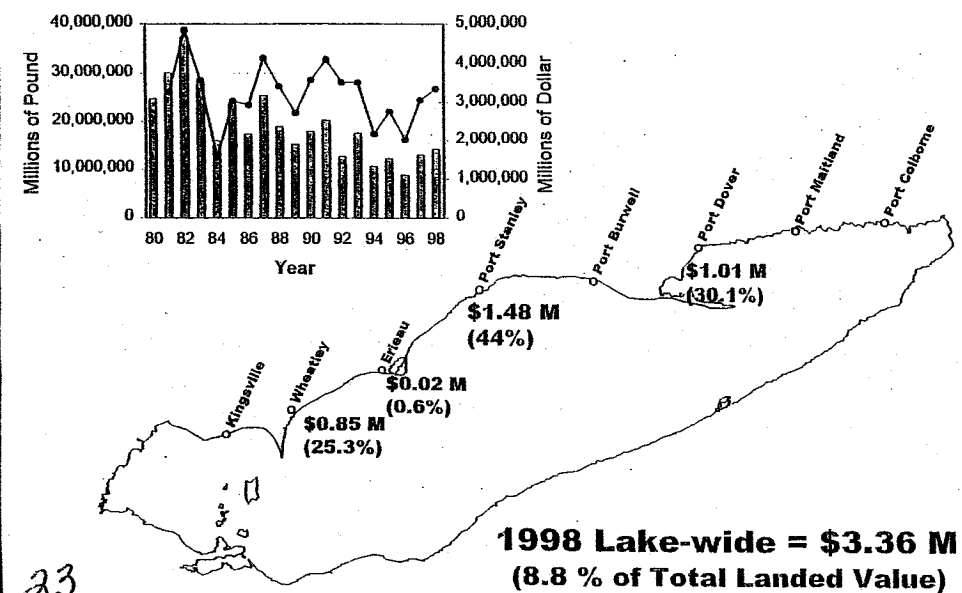
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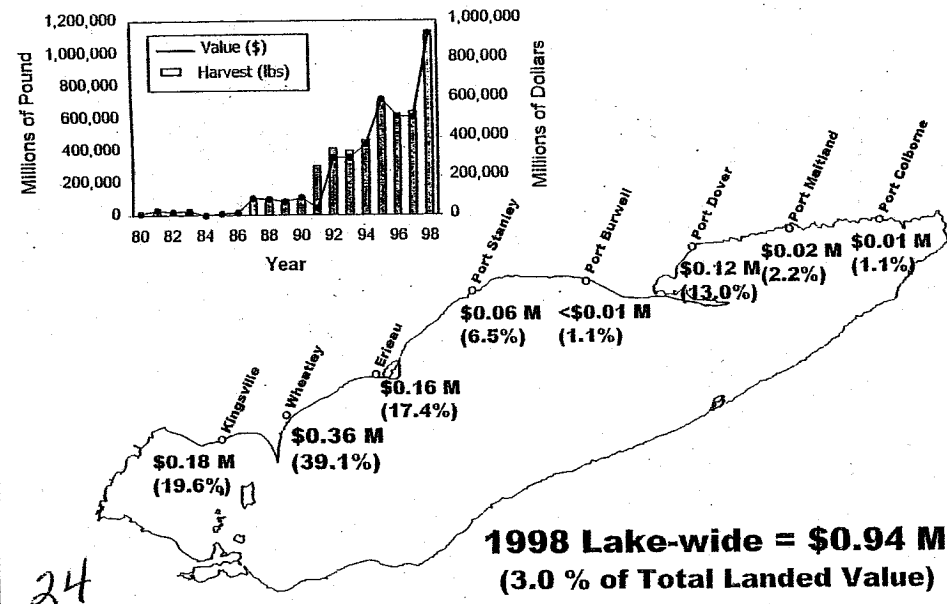
## Canadian Commerical Yellow Perch Harvest Trend and 1998 Landed Value by Port



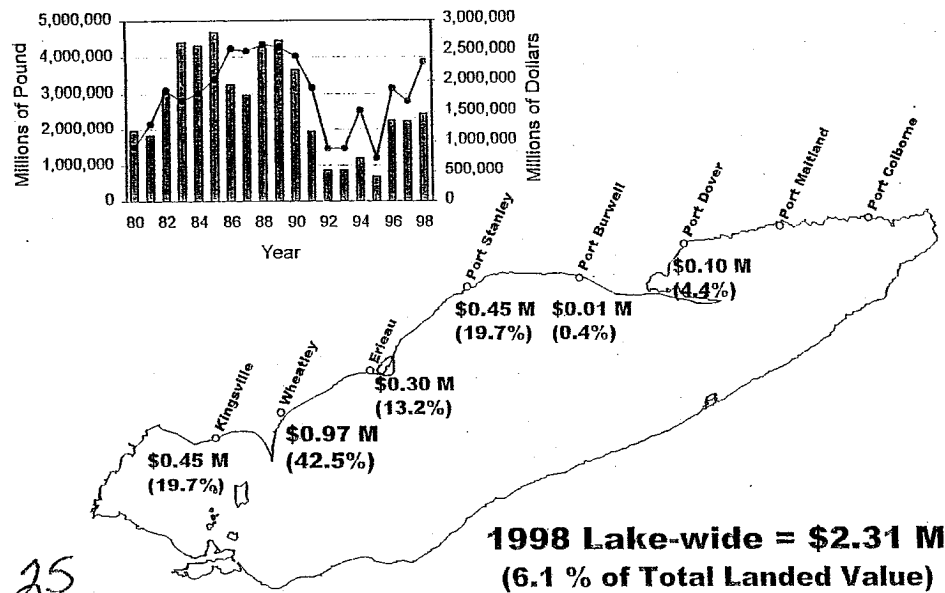
## Canadian Commerical Rainbow Smelt Harvest Trend and 1998 Landed Value by Port



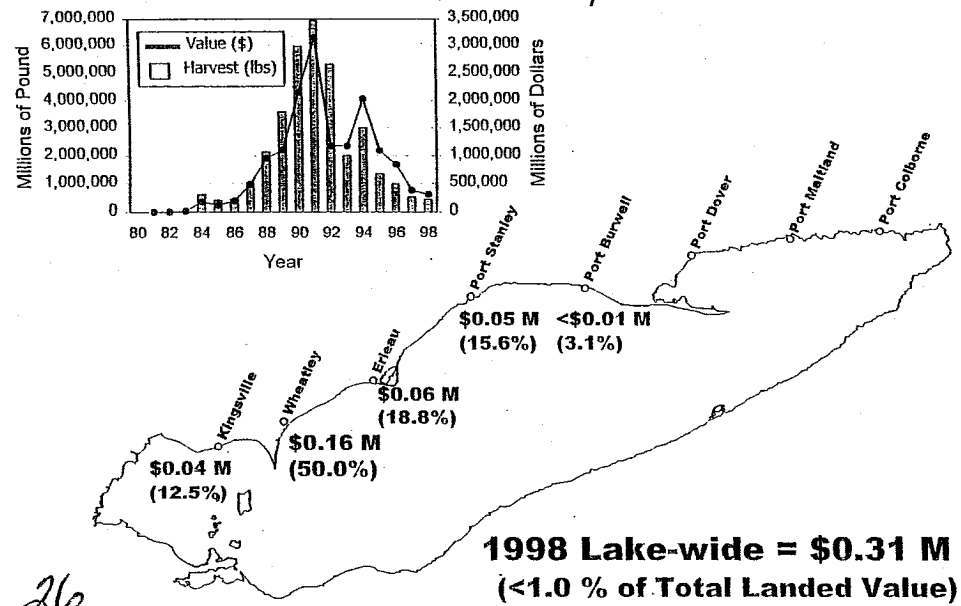
## Canadian Commerical Whitefish Harvest Trend and 1998 Landed Value by Port



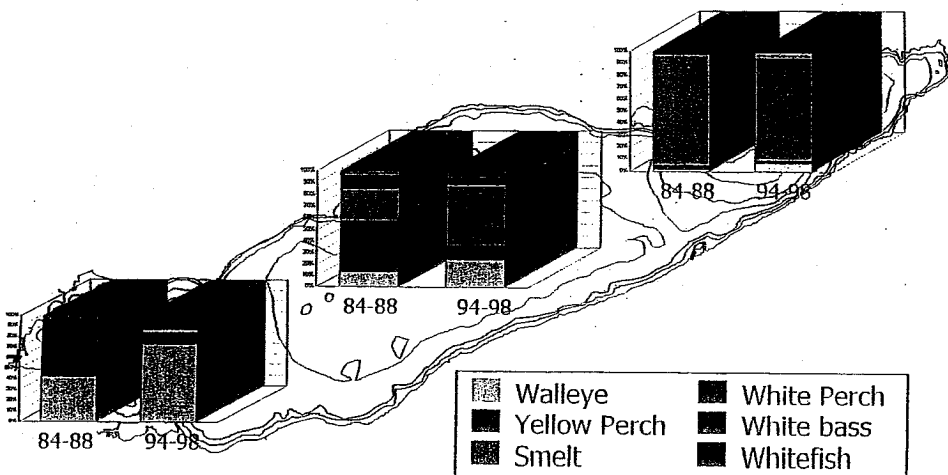
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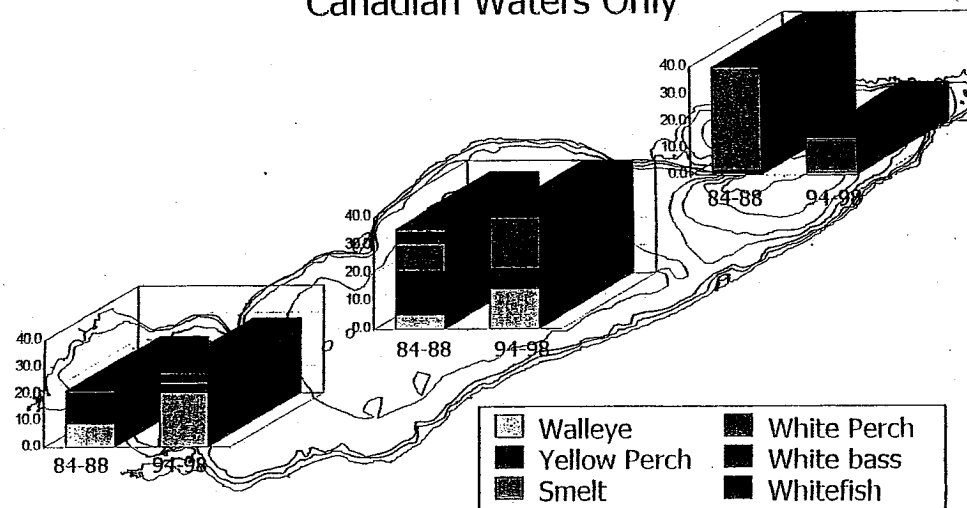
## Canadian Commerical White Perch Harvest Trend and 1998 Landed Value by Port



## Percent of Basin Harvest (lbs) by Species, 1984-88 (pre-zebra) and 1994-98 Averages Canadian Waters Only



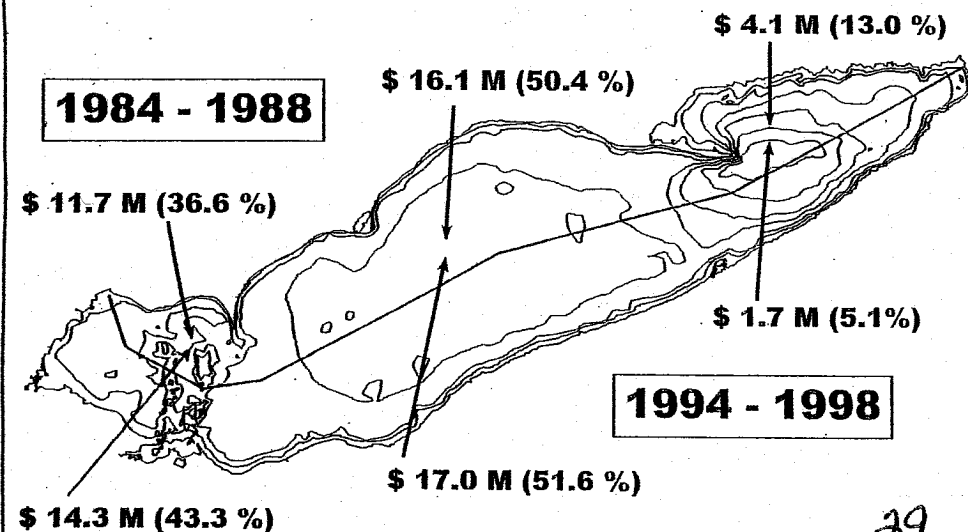
## Percent of Lake-wide Harvest (lbs) by Species and Basin, 1984-88 and 1994-98 Averages Canadian Waters Only



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**1994 - 1998**



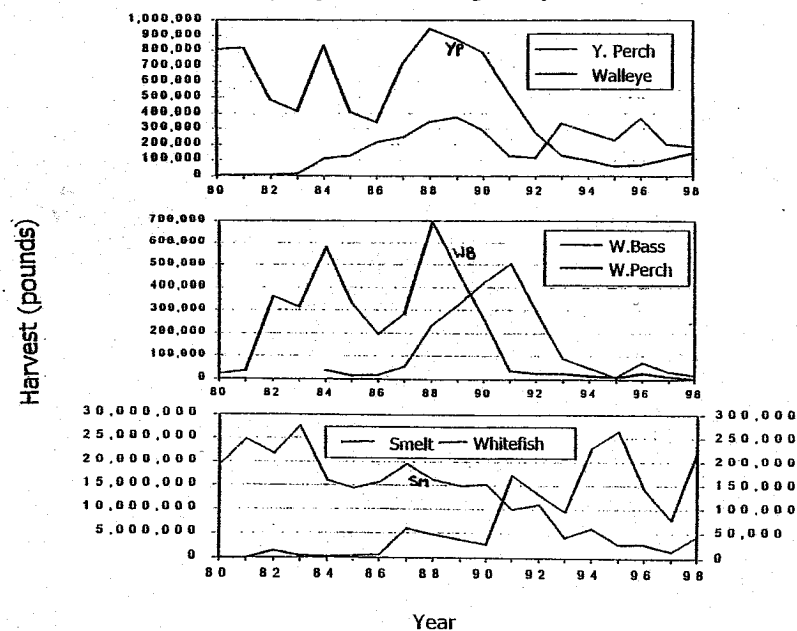
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Five Year Averages for the Lake-wide Commercial  
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## Industry Today

- Largest freshwater commercial fishery in the world
  - despite major and on-going changes in fish community and ecosystem

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- Major gear restrictions and restrictions on the sale of some highly valued species have substantially reduced U.S. contribution to lakewide commercial harvest
- Commercial operations now restricted to live capture gear
- Approximately 38 active licenses in U.S. comprised of seine and trapnet fisheries
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- 38 million dollars landed value in 1998
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  - large investment in specific technologies
- **Major investments in Lake Erie percids**
  - harvest technologies, processing and marketing
- **Yellow perch and walleye make up 84% of total value**
  - 70% reduction in perch harvest since '80-84
- **Walleye harvests have increased by 72%**
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- Concerned that water quality agencies may not be considering fish community structure and production
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- Concerned that harvest estimates (principally sport fish) are not rigorous and question their accuracy
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- Want effective controls and monitoring on all resource use (commercial, sport and baitfish extraction)
- Concerned over apparent declines in abundance, distribution and species composition of forage base

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### Ecosystem and Fish Community

- Relationship of lower trophic levels and water quality parameters to fish production, fish community structure and composition
- Food-web dynamics and influence on key commercial species
- Improved fish community and ecosystem approaches to fisheries management
- Develop means of achieving FCGO's
- Improved understanding of ecosystem, fish community and stock dynamics
- Restoration of optimal ecosystem for percids
- Improved understanding and management of forage base based on strong science

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## Habitat

- Determine optimum habitat requirements for major commercial species (esp. percids)
- Develop and test methods to return optimal environmental conditions for percids
- Identification of critical habitats for key commercial fish species
  - implement strong habitat improvement and protection strategies

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## Restoration

- Restoration of native fish species
  - understand implications to production of highly valued commercial species
  - assess harvest potential
- Restoration of healthy, productive fisheries in east basin based on highly valued species
- Restore critical habitats for highly valued species
- Develop specific fish community and ecosystem approaches to rehabilitation and protection of key commercial species

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- Improve methods of estimating abundance and safe harvest levels
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- Improved understanding of the effects of exotic species invasions on dynamics of key commercial fish species
- Improved biological, technological and management techniques to prevent/manage exotic species
- Identify optimum fish community resilient to exotic species invasions

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### Fish Stock Dynamics

- Identify discrete stocks of key commercial fish species and their present/potential importance to sustainable, productive fisheries
- Develop stock protection and enhancement strategies based on sound science
- Develop harvest management strategies with due regard for stock concept

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### COMMERCIAL FISHERY

#### Next 5 Years

46

### 5-Year Projection

- Industry relies heavily on yellow perch, walleye and smelt
- Further declines in yellow perch and walleye will jeopardize industry viability
- Will continue to explore opportunities for marketing other species
- Whitefish up and coming
- Demanding improved science and assessment aimed at ensuring longterm sustainability and productivity of highly valued species (esp. y. perch, walleye)
- Needs lead-time to adapt and develop new markets, adapt technologies - wants improved forecasting
- Restoration of highly valued species in east basin fish community

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## Commercial Fishery in Lake Erie: Coping with Change

Rob MacGregor  
Ontario Ministry of Natural Resources  
Lake Erie Management Unit

1

## BACKGROUND AND RELEVANCE TO PRIORITIES

2

### Ecosystem Challenges

- 13 million people in basin
- Careless development, substantial degradation of ecosystem

3

### Stresses on Fish Communities

- Overexploitation
- Degraded tributaries, dams
- Alteration, destruction of fish habitat
- Toxic loadings, fish flesh advisories (closure of walleye fishery 1970-73)
- Loss of burrowing mayflies
- Substantial loss of wetlands, spawning and nursery habitat
- Nutrient enrichment, Cladophora, oxygen depletion
- Exotic species:
  - lamprey, carp, smelt, white perch, alewife, Bythotrephes, zebra and quagga mussels, gobies

4

## Past Fish Community Responses

- Successive depression/collapse/loss of native species:
  - lake trout, lake sturgeon, lake herring, whitefish, sauger, blue pike (extinct), walleye
- All native terminal predators lost or severely reduced by 1970s
- Most large native planktivores and bentivores lost or reduced
- Explosive and pervasive invasion of exotic species
  - small, short-lived planktivores
  - astatic, unpredictable fish community

5

## Changes in the 1980s and 1990s

- Ecosystem, unstable and unpredictable
- Phosphorus controls
  - control algal production
- Zebra and quagga mussel invasion
- Oligotrophication in all basins
  - high transparencies, lower productivity
- Change, loss of habitat
  - transparency/walleye habitat?
- Increased abundance of predators
  - walleye resurgence
  - high lake trout biomass
  - burbot increase
- Resurgence of whitefish, lake sturgeon
- Increase in smallmouth bass and muskellunge
- Strong declines in:
  - white perch, y. perch, smelt
- Shifts in distribution
  - walleye deeper, smelt increase in C. Basin
- Decreased abundance and growth of walleye
- Declining growth and condition of smelt
- Declining recruitment of yellow perch
- Unknown effects of recent exotics
  - gobies, Bythotrephes, Ceratopagis
  - river ruffe?

6

## Changes Most Pronounced in East Basin

- Approaching ultra-oligotrophic conditions
- Loss of Diporeia
- Vastly reduced yellow perch abundance
- Strong declines in smelt abundance, growth, condition
- Reduced eastward migration of western walleye stocks
- Rainbow trout, smallmouth bass up
- Whitefish and burbot more abundant
- Total harvest down by 77%; 59% reduction in landed value

7

## General Questions

- Extent of oligotrophication, effects on fish production and fish community structure?
- Role of zebra and quagga mussels, role of phosphorus controls?
- How much further will oligotrophication progress? East Central Basin issues?
- Relative role of top-down, bottom-up effects?
- Future of percids in Lake Erie?

8

## Management Changes

- Gill net bans in all states
- Restrictions on sale of walleye harvested from U.S. waters
- 1984 implementation of quota management in Ontario
- Gillnet mesh size restrictions in Ontario
- Size restrictions in U.S
- Season closures (e.g., Ontario restrictions on spring harvest of yellow perch since 1995)
- Ontario cap on E. Basin smelt harvest
- Reductions in lake Trout stocking
- Ontario royalties
- New Business Relationship with OCFA
  - royalty administration, compliance monitoring, supplemental assessment, data entry and data management agreements
- Code of Conduct for Responsible Fishing Practices
- Directed enforcement approach

9

## Contaminant and Human Health Issues

- Contaminants have caused past disruptions
  - closure of walleye fishery in early 70s
- Presently only one restriction in Ontario for commercial fishery (large channel catfish)
- Zebra mussel effects and apparent shift to benthically driven system may alter contaminant pathways
  - potential effects on fish flesh, human health and market for Lake Erie fish?
- Ontario changes in sport fish advisories; differing contaminant advisories among agencies and jurisdictions?

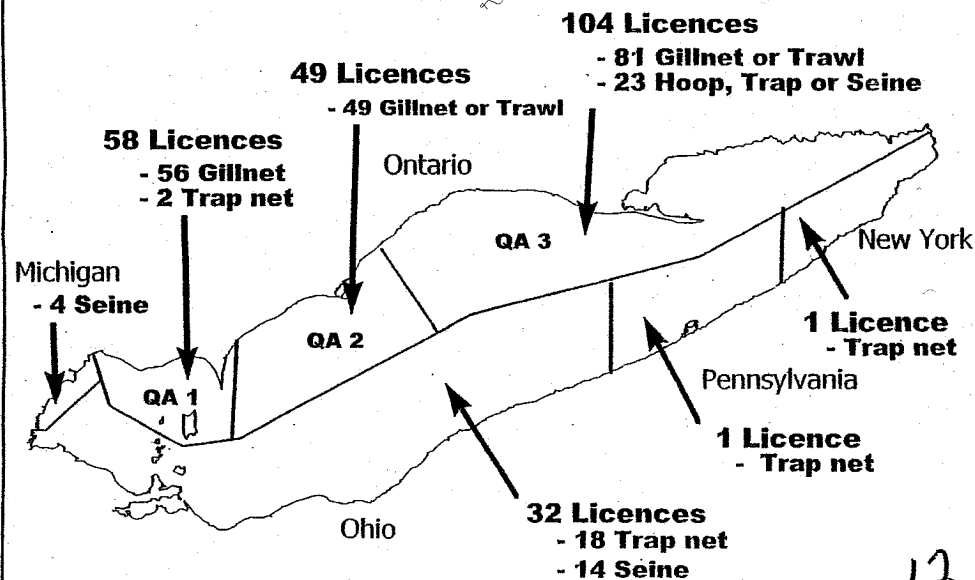
10

## Responses by Commercial Fishery

- Regulation changes have lead to vast reductions in US commercial harvests
- Forced to learn, respond, adapt quickly to ecosystem changes:
  - take advantage of abundant species (smelt, white perch)
  - new technologies (selective square mesh trawl for whitefish, major trawl fishery for smelt)
- Develop new markets:
  - Japanese market for smelt
  - white perch
- Develop innovative markets
  - live capture and transport to fish-out ponds, ethnic markets
- Change price structure in accordance with supply

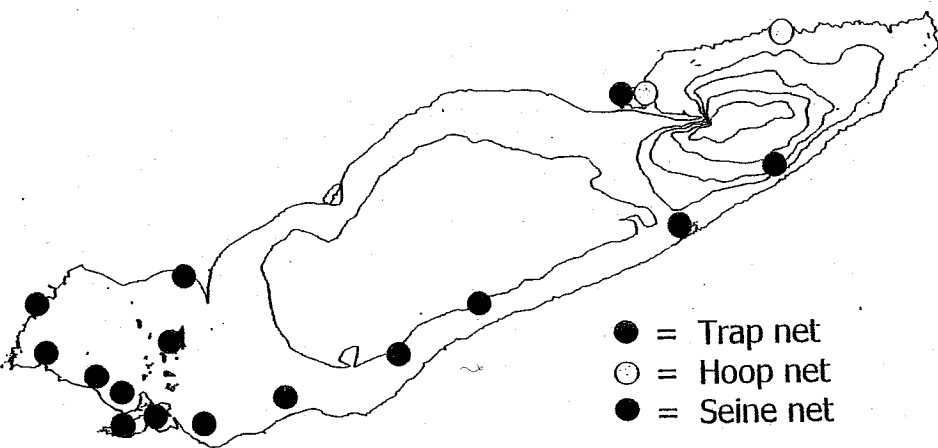
11

## Number of Commercial Fishing Licenses by Quota Area or Jurisdiction



12

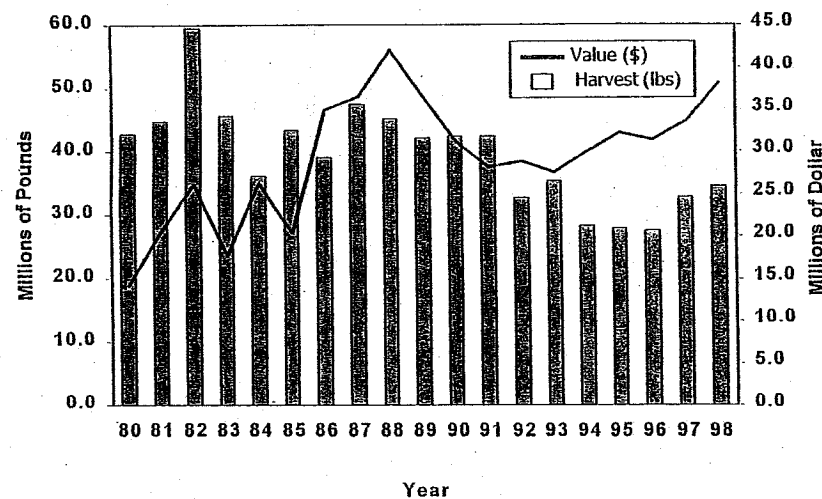
# Location of Seine, Trap Net, and Hoop Net Fisheries on Lake Erie, 1998



Markers indicate general location only and don't represent overall abundance

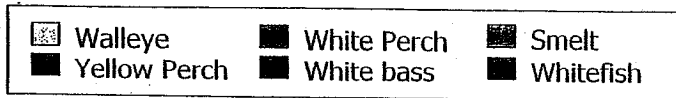
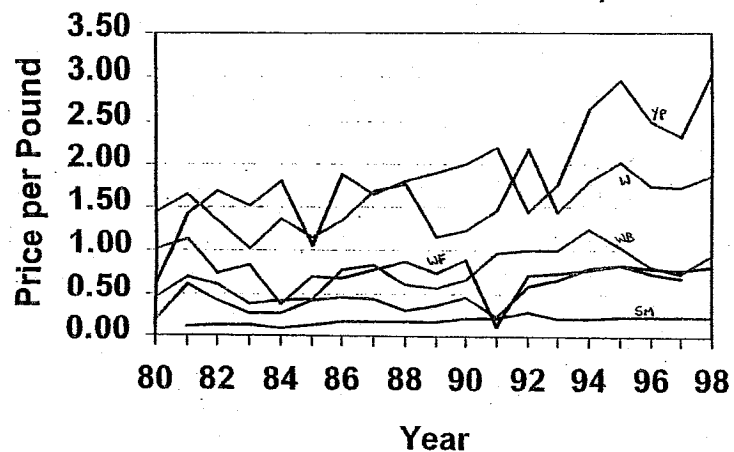
13

# Lake-Wide Annual Landed Weight and Landed Value of Canadian Commercial Fishery



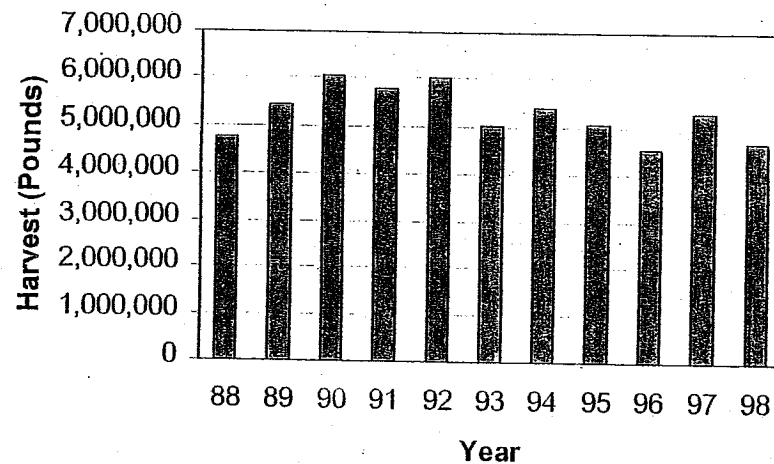
14

# Price per Pound - Landed Value Canadian Commercial Fishery



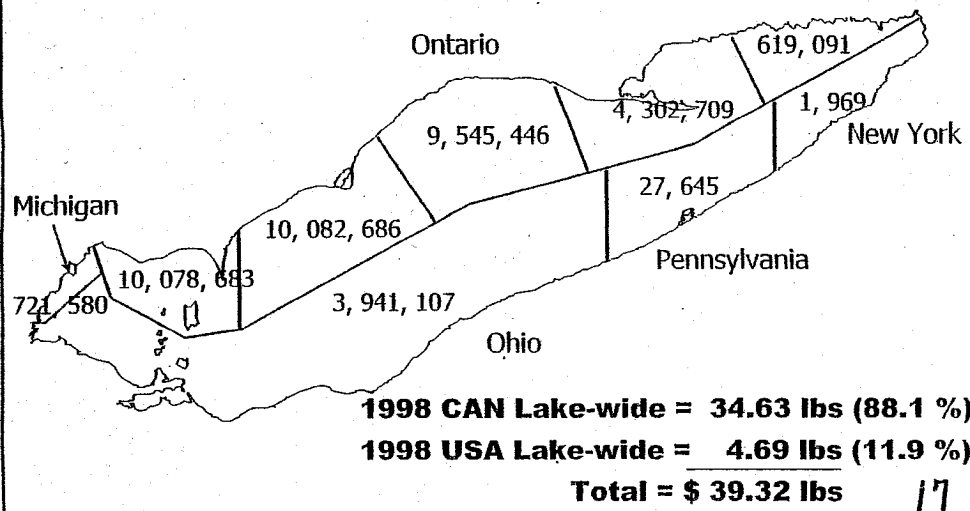
15

# United States 1988-98 Commercial Harvest (lbs) NY, MI, OH, PE Combined

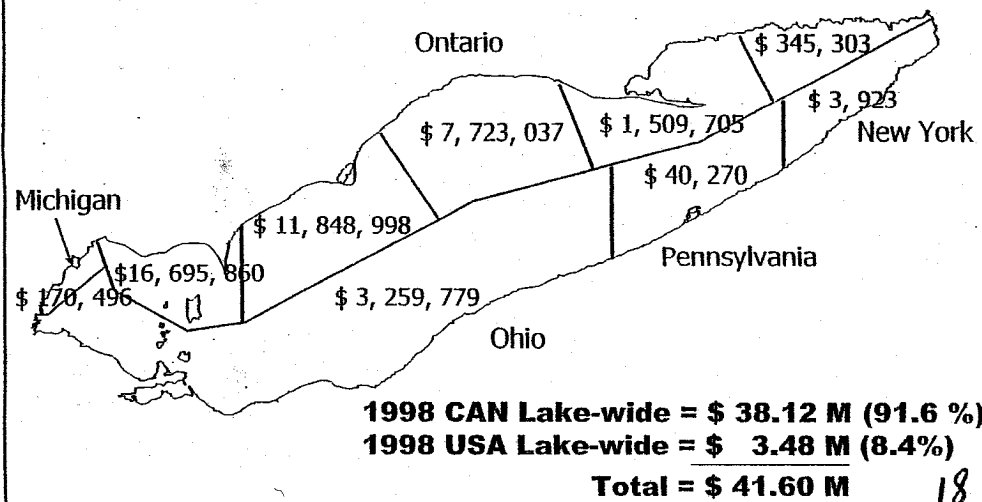


16

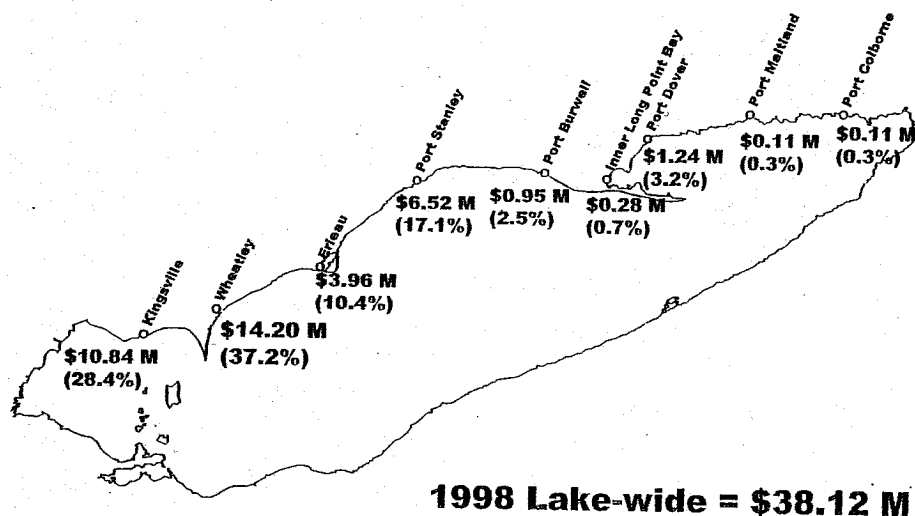
1998 Landed Weight (in lbs) of Lake Erie's Commercial Fishery by Jurisdiction and Statistical Area, All Species and Gear Combined



1998 Landed Value (in Canadian dollars) of Lake Erie's Commercial Fishery by Jurisdiction and Statistical Area, All Species and Gear Combined



1998 Landed Value of Canadian Commercial Fishery by Port, All Species

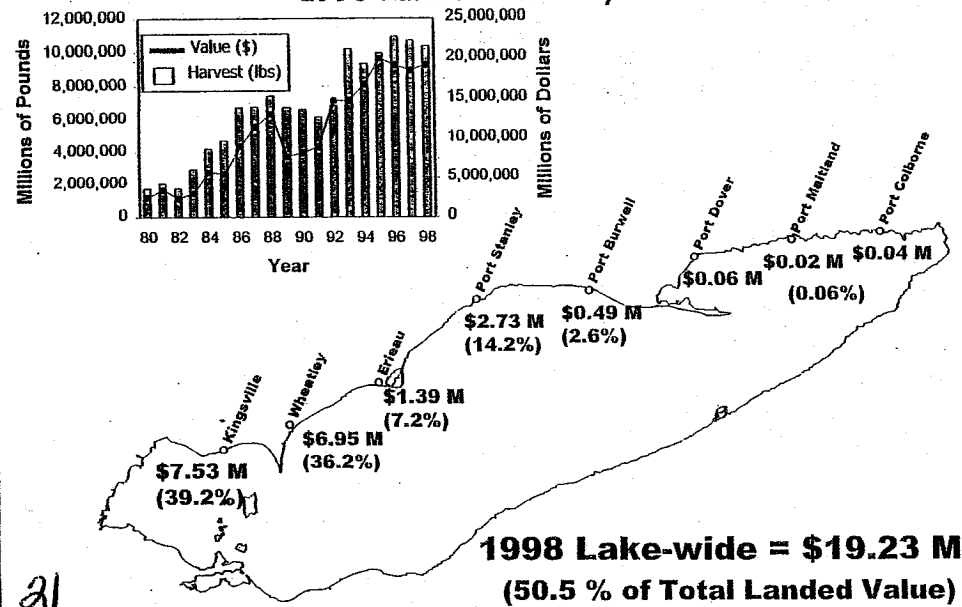


Top 5 Commercially Harvested Species in 1998, by Country

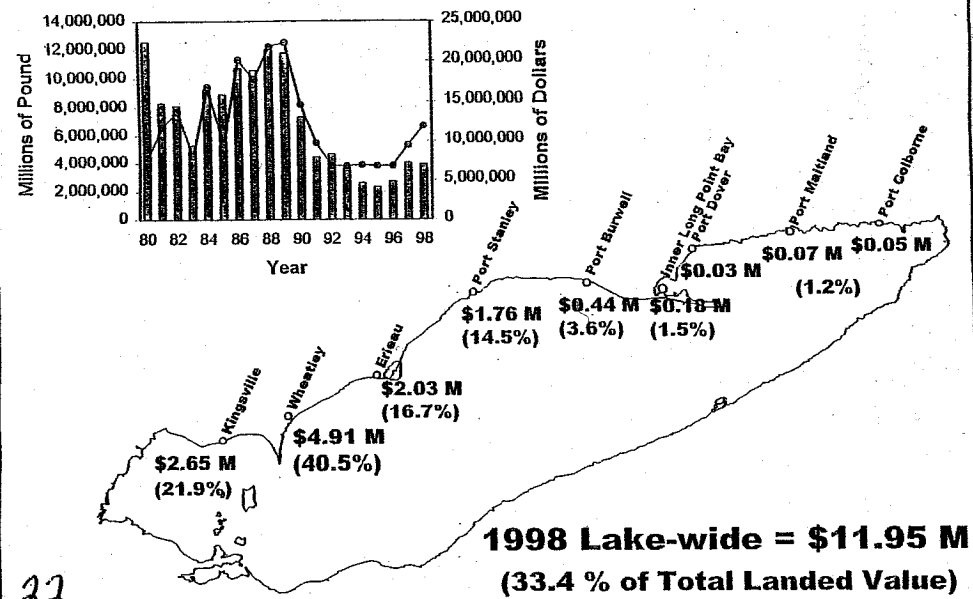
United States		
Species	1998 Harvest (lbs)	% of Total Harvest
Carp	1,956,597	41.7
Yellow Perch	586,758	12.5
F.W. Drum	578,784	12.3
Buffalo	311,625	6.6
Channel Cat	302,056	6.4
Total '98 Harvest	4,690,564	

Canada		
Species	1998 Harvest (lbs)	% of Total Harvest
Small	14,180,253	40.9
Walleye	10,332,228	29.8
Yellow Perch	3,936,665	11.3
White Bass	2,449,457	7.1
Whitefish	1,138,449	3.3
Total '98 Harvest	34,708,054	

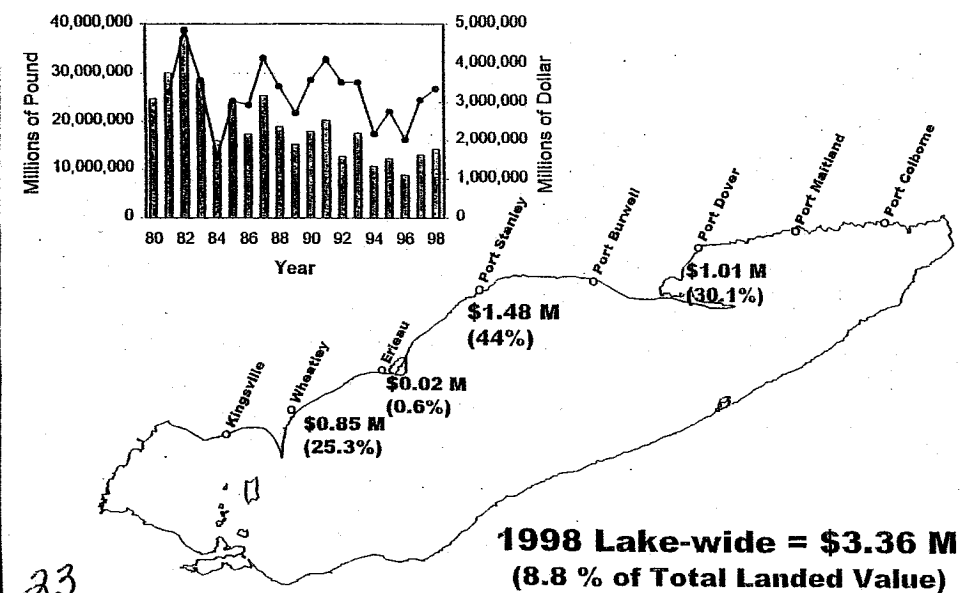
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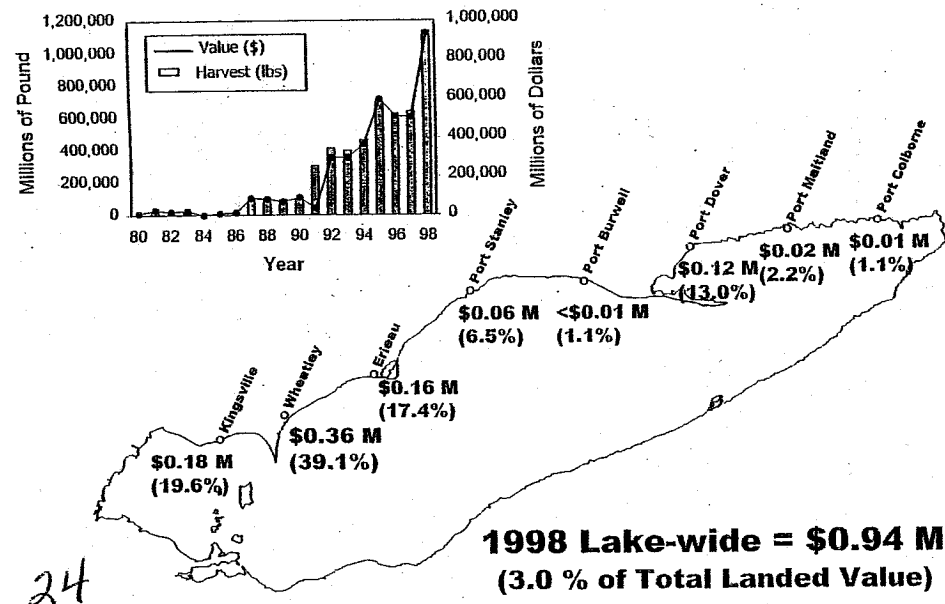
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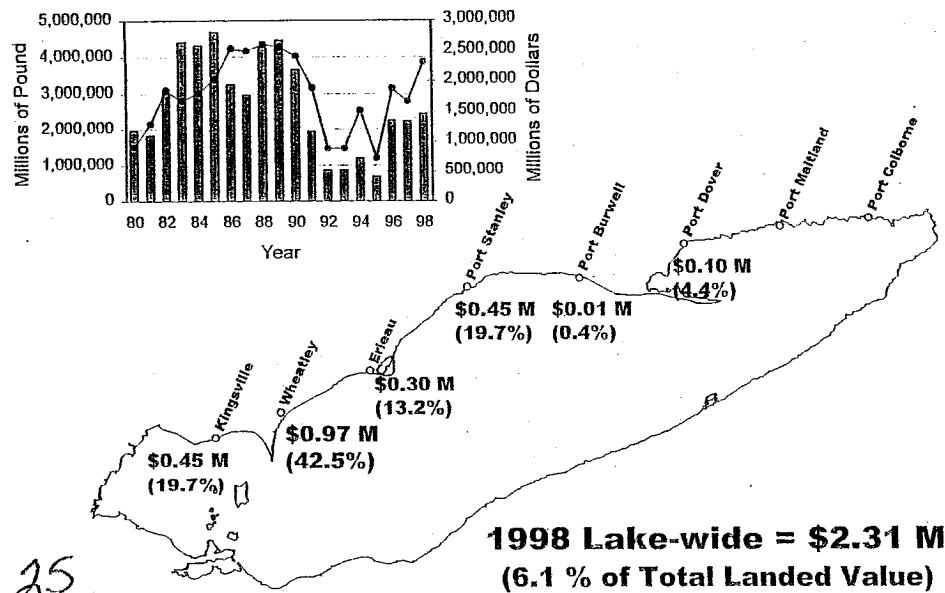
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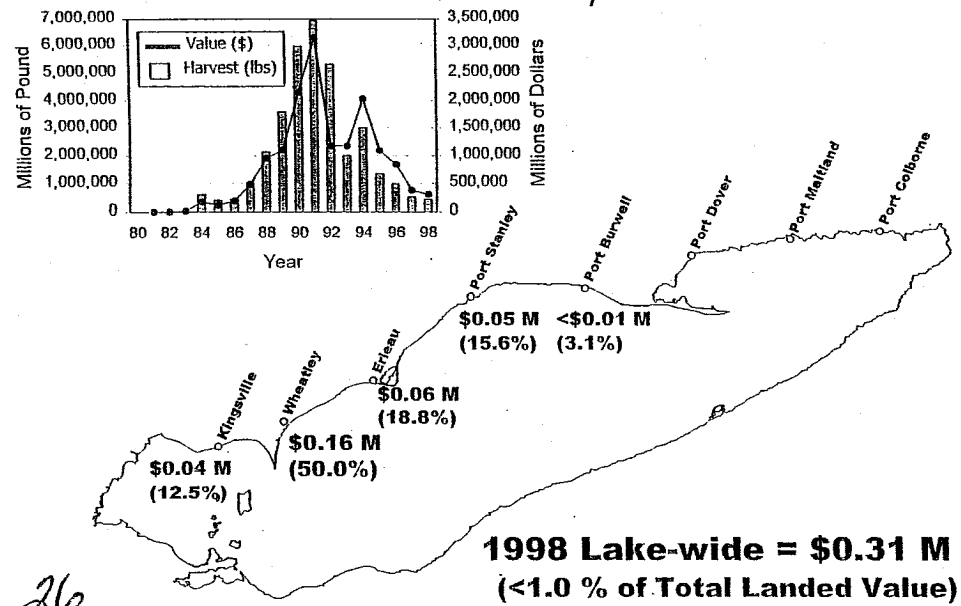
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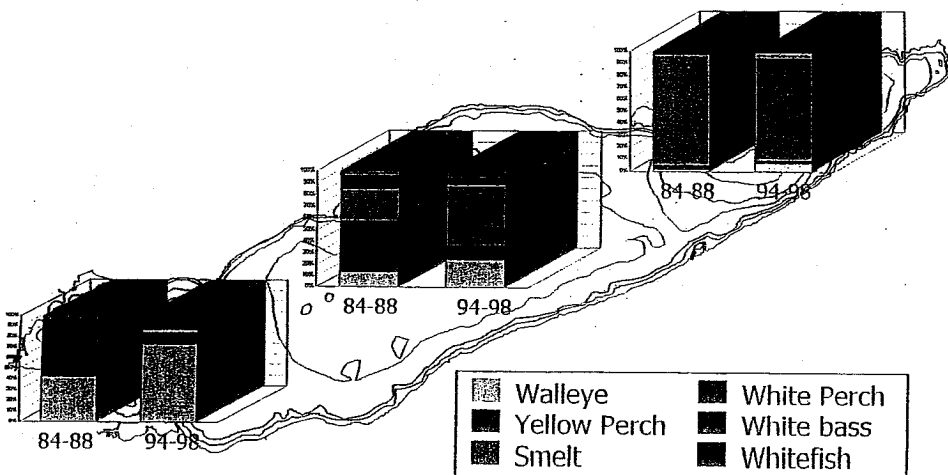
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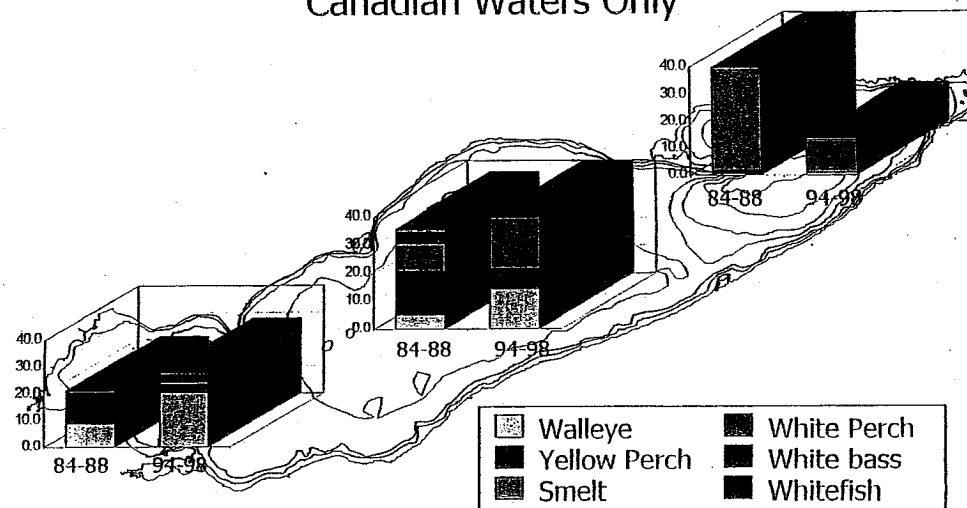
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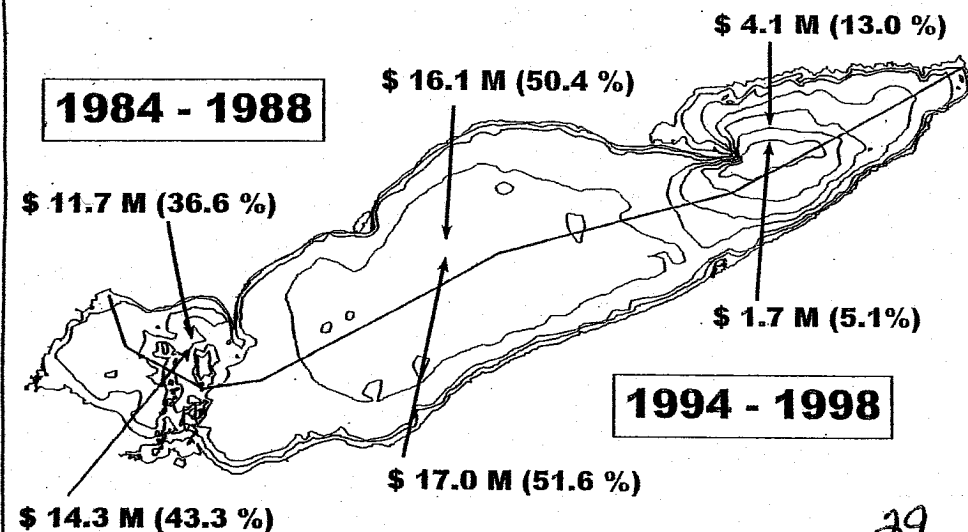
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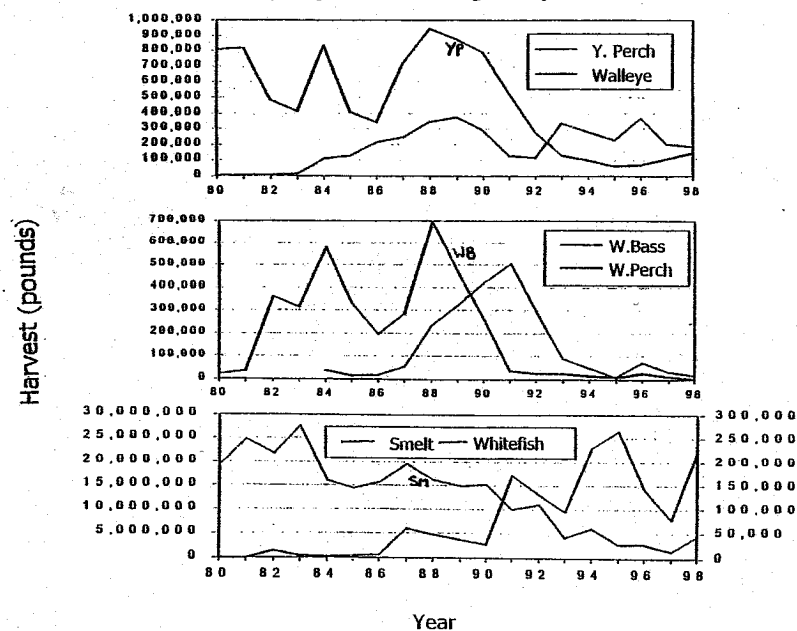
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### COMMERCIAL FISHERY

#### Next 5 Years

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### 5-Year Projection

- Industry relies heavily on yellow perch, walleye and smelt
- Further declines in yellow perch and walleye will jeopardize industry viability
- Will continue to explore opportunities for marketing other species
- Whitefish up and coming
- Demanding improved science and assessment aimed at ensuring longterm sustainability and productivity of highly valued species (esp. y. perch, walleye)
- Needs lead-time to adapt and develop new markets, adapt technologies - wants improved forecasting
- Restoration of highly valued species in east basin fish community

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## Commercial Fishery in Lake Erie: Coping with Change

Rob MacGregor  
Ontario Ministry of Natural Resources  
Lake Erie Management Unit

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## BACKGROUND AND RELEVANCE TO PRIORITIES

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### Ecosystem Challenges

- 13 million people in basin
- Careless development, substantial degradation of ecosystem

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### Stresses on Fish Communities

- Overexploitation
- Degraded tributaries, dams
- Alteration, destruction of fish habitat
- Toxic loadings, fish flesh advisories (closure of walleye fishery 1970-73)
- Loss of burrowing mayflies
- Substantial loss of wetlands, spawning and nursery habitat
- Nutrient enrichment, Cladophora, oxygen depletion
- Exotic species:
  - lamprey, carp, smelt, white perch, alewife, Bythotrephes, zebra and quagga mussels, gobies

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## Past Fish Community Responses

- Successive depression/collapse/loss of native species:
  - lake trout, lake sturgeon, lake herring, whitefish, sauger, blue pike (extinct), walleye
- All native terminal predators lost or severely reduced by 1970s
- Most large native planktivores and bentivores lost or reduced
- Explosive and pervasive invasion of exotic species
  - small, short-lived planktivores
  - astatic, unpredictable fish community

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## Changes in the 1980s and 1990s

- Ecosystem, unstable and unpredictable
- Phosphorus controls
  - control algal production
- Zebra and quagga mussel invasion
- Oligotrophication in all basins
  - high transparencies, lower productivity
- Change, loss of habitat
  - transparency/walleye habitat?
- Increased abundance of predators
  - walleye resurgence
  - high lake trout biomass
  - burbot increase
- Resurgence of whitefish, lake sturgeon
- Increase in smallmouth bass and muskellunge
- Strong declines in:
  - white perch, y. perch, smelt
- Shifts in distribution
  - walleye deeper, smelt increase in C. Basin
- Decreased abundance and growth of walleye
- Declining growth and condition of smelt
- Declining recruitment of yellow perch
- Unknown effects of recent exotics
  - gobies, Bythotrephes, Ceratopagis
  - river ruffe?

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## Changes Most Pronounced in East Basin

- Approaching ultra-oligotrophic conditions
- Loss of Diporeia
- Vastly reduced yellow perch abundance
- Strong declines in smelt abundance, growth, condition
- Reduced eastward migration of western walleye stocks
- Rainbow trout, smallmouth bass up
- Whitefish and burbot more abundant
- Total harvest down by 77%; 59% reduction in landed value

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## General Questions

- Extent of oligotrophication, effects on fish production and fish community structure?
- Role of zebra and quagga mussels, role of phosphorus controls?
- How much further will oligotrophication progress? East Central Basin issues?
- Relative role of top-down, bottom-up effects?
- Future of percids in Lake Erie?

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## Management Changes

- Gill net bans in all states
- Restrictions on sale of walleye harvested from U.S. waters
- 1984 implementation of quota management in Ontario
- Gillnet mesh size restrictions in Ontario
- Size restrictions in U.S
- Season closures (e.g., Ontario restrictions on spring harvest of yellow perch since 1995)
- Ontario cap on E. Basin smelt harvest
- Reductions in lake Trout stocking
- Ontario royalties
- New Business Relationship with OCFA
  - royalty administration, compliance monitoring, supplemental assessment, data entry and data management agreements
- Code of Conduct for Responsible Fishing Practices
- Directed enforcement approach

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## Contaminant and Human Health Issues

- Contaminants have caused past disruptions
  - closure of walleye fishery in early 70s
- Presently only one restriction in Ontario for commercial fishery (large channel catfish)
- Zebra mussel effects and apparent shift to benthically driven system may alter contaminant pathways
  - potential effects on fish flesh, human health and market for Lake Erie fish?
- Ontario changes in sport fish advisories; differing contaminant advisories among agencies and jurisdictions?

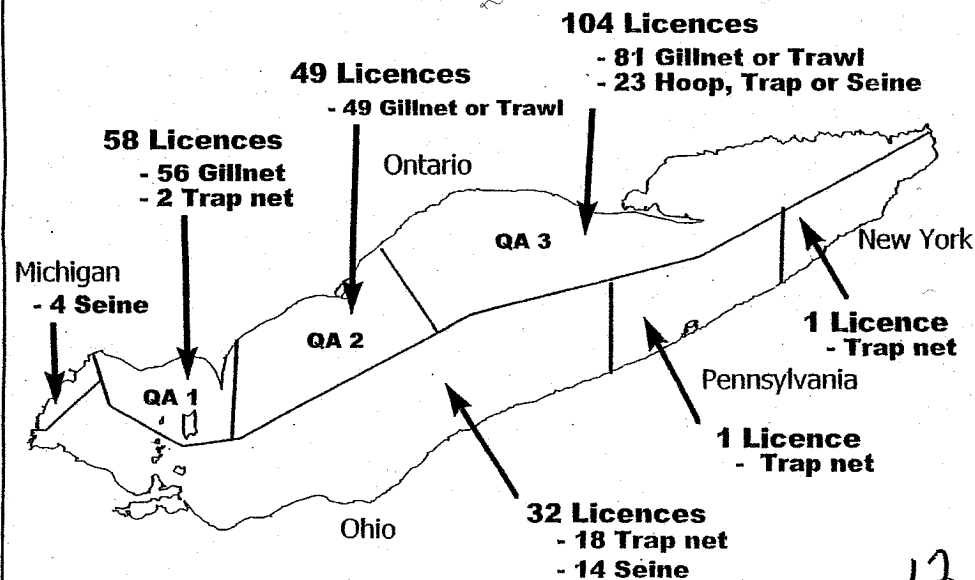
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## Responses by Commercial Fishery

- Regulation changes have lead to vast reductions in US commercial harvests
- Forced to learn, respond, adapt quickly to ecosystem changes:
  - take advantage of abundant species (smelt, white perch)
  - new technologies (selective square mesh trawl for whitefish, major trawl fishery for smelt)
- Develop new markets:
  - Japanese market for smelt
  - white perch
- Develop innovative markets
  - live capture and transport to fish-out ponds, ethnic markets
- Change price structure in accordance with supply

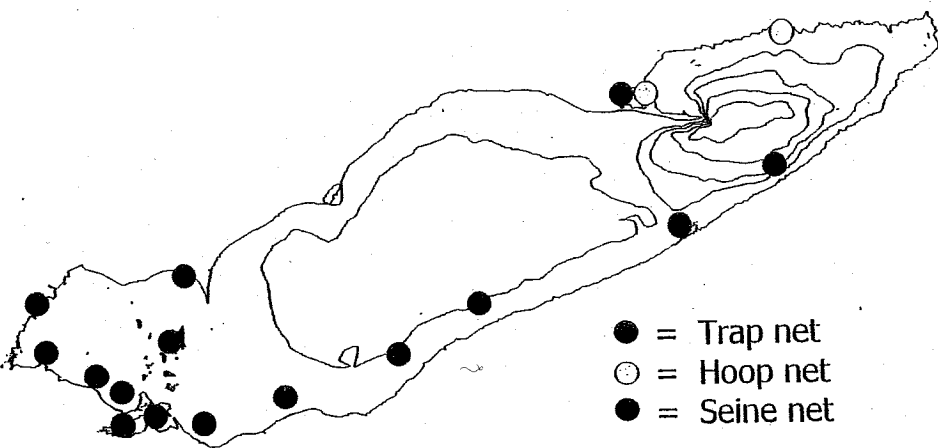
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## Number of Commercial Fishing Licenses by Quota Area or Jurisdiction



12

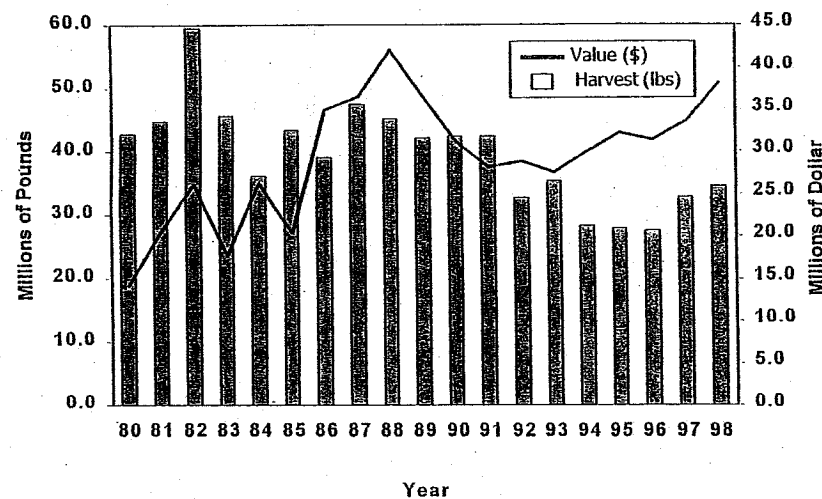
# Location of Seine, Trap Net, and Hoop Net Fisheries on Lake Erie, 1998



Markers indicate general location only and don't represent overall abundance

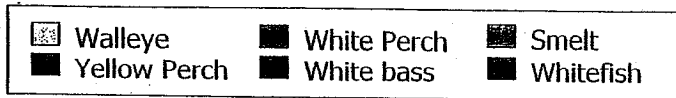
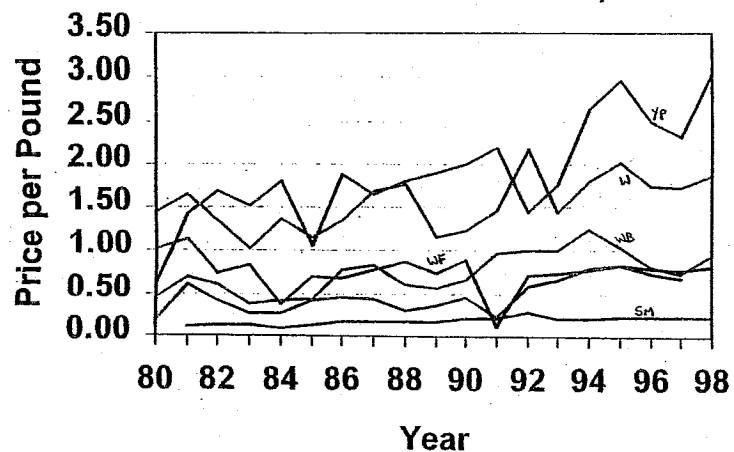
13

# Lake-Wide Annual Landed Weight and Landed Value of Canadian Commercial Fishery



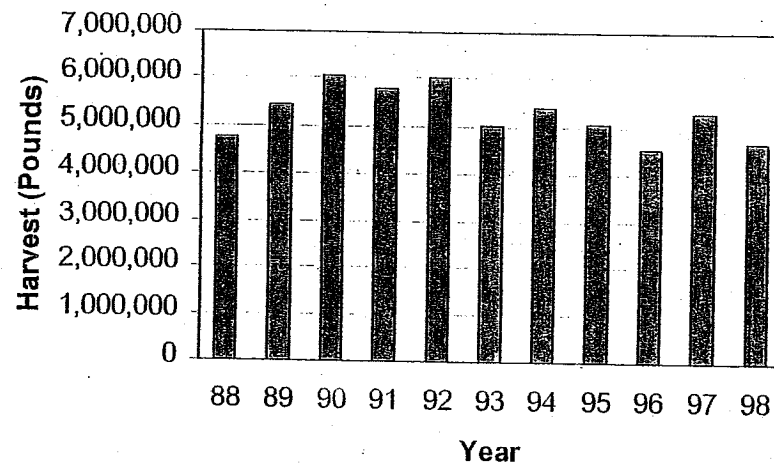
14

# Price per Pound - Landed Value Canadian Commercial Fishery



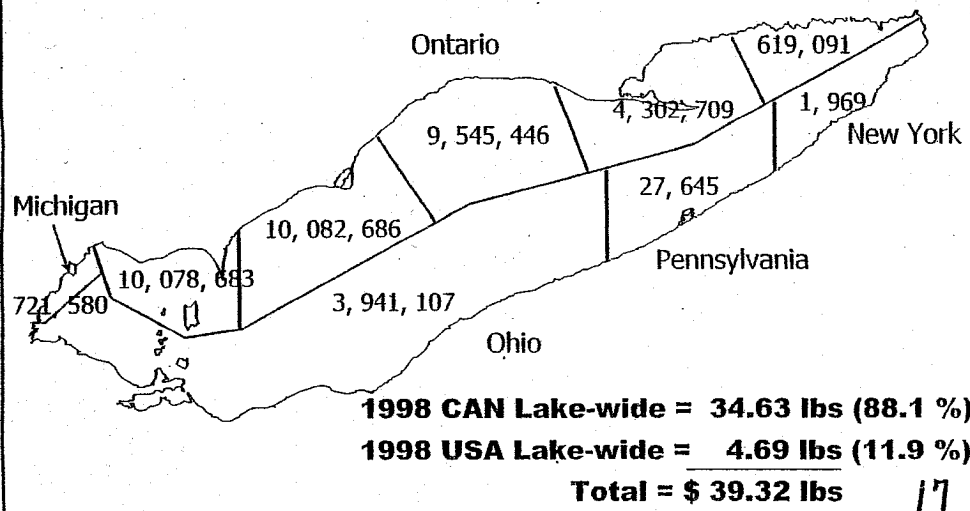
15

# United States 1988-98 Commercial Harvest (lbs) NY, MI, OH, PE Combined

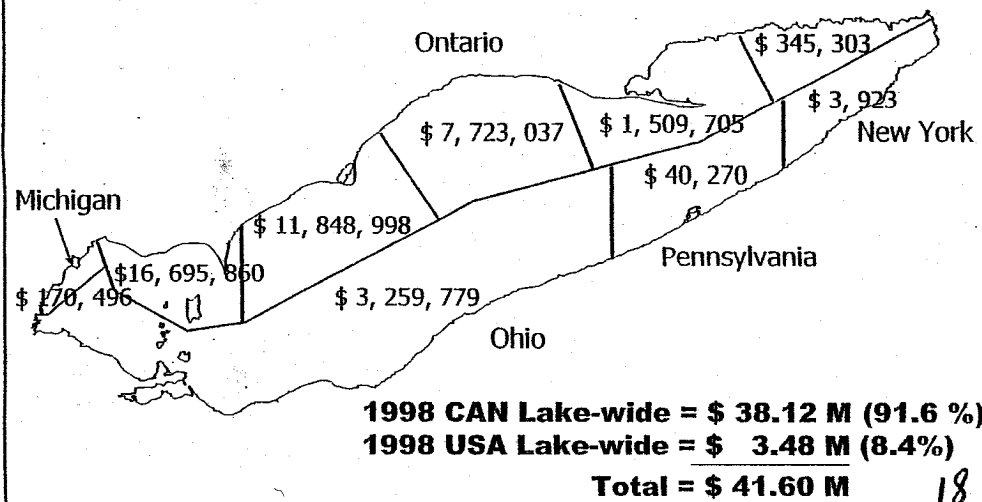


16

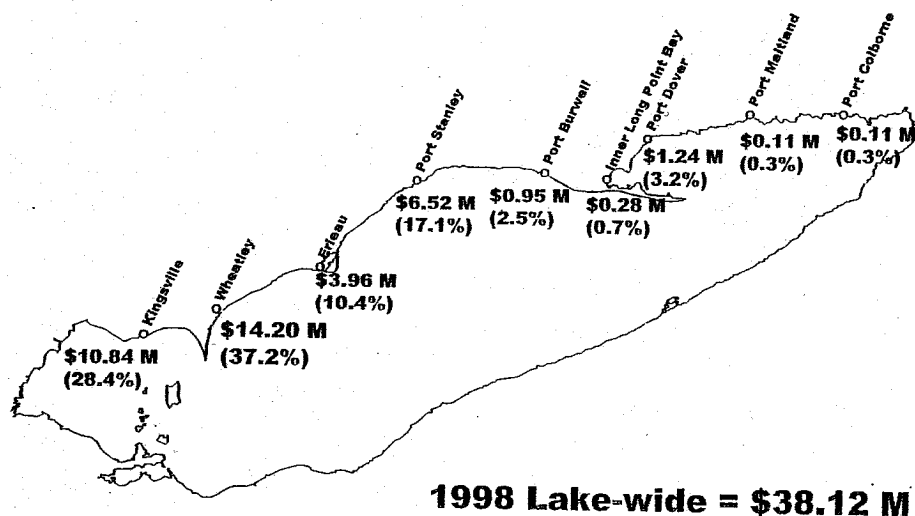
1998 Landed Weight (in lbs) of Lake Erie's Commercial Fishery by Jurisdiction and Statistical Area, All Species and Gear Combined



1998 Landed Value (in Canadian dollars) of Lake Erie's Commercial Fishery by Jurisdiction and Statistical Area, All Species and Gear Combined



1998 Landed Value of Canadian Commercial Fishery by Port, All Species

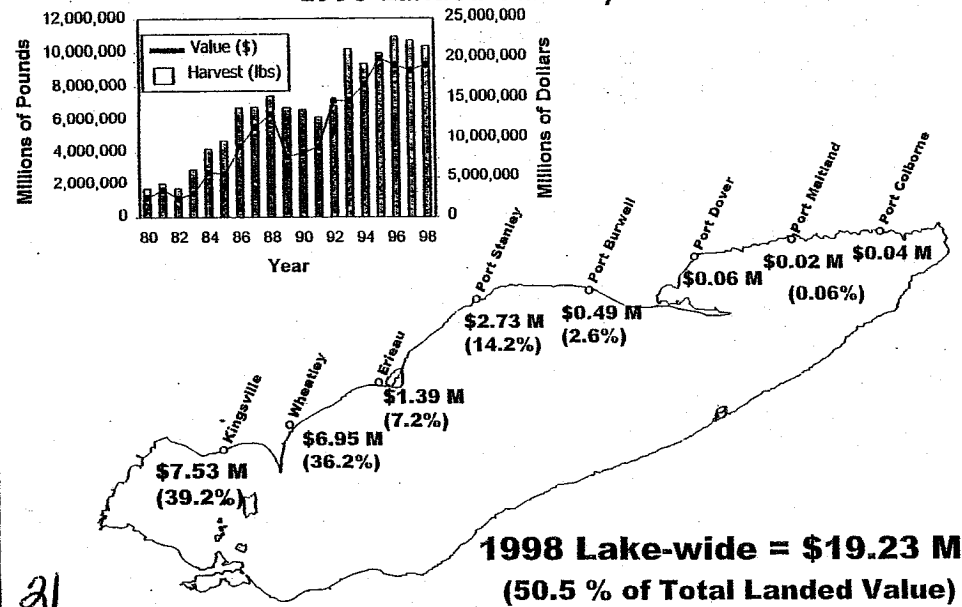


Top 5 Commercially Harvested Species in 1998, by Country

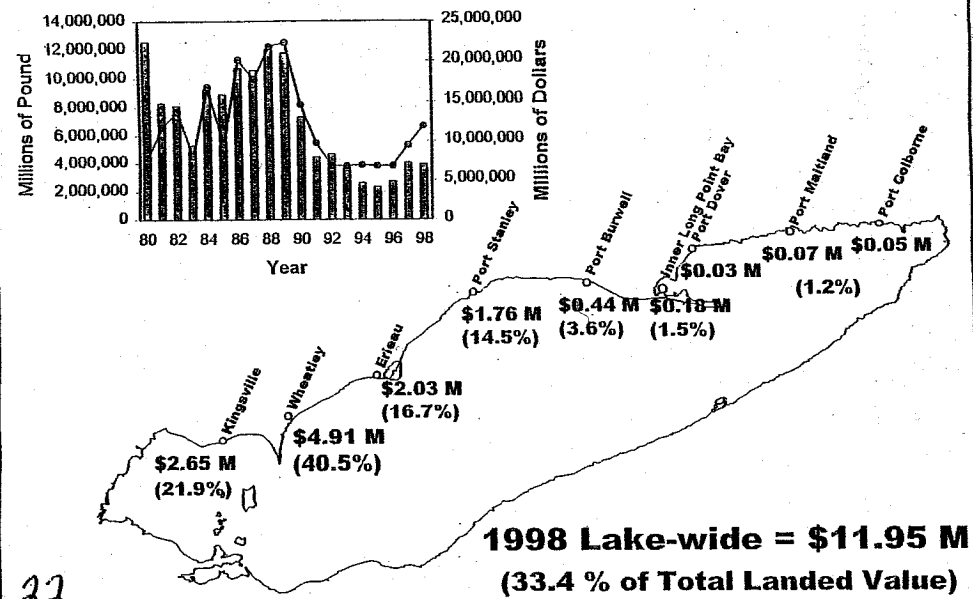
United States		
Species	1998 Harvest (lbs)	% of Total Harvest
Carp	1,956,597	41.7
Yellow Perch	586,758	12.5
F.W. Drum	578,784	12.3
Buffalo	311,625	6.6
Channel Cat	302,056	6.4
Total '98 Harvest	4,690,564	

Canada		
Species	1998 Harvest (lbs)	% of Total Harvest
Small	14,180,253	40.9
Walleye	10,332,228	29.8
Yellow Perch	3,936,665	11.3
White Bass	2,449,457	7.1
Whitefish	1,138,449	3.3
Total '98 Harvest	34,708,054	

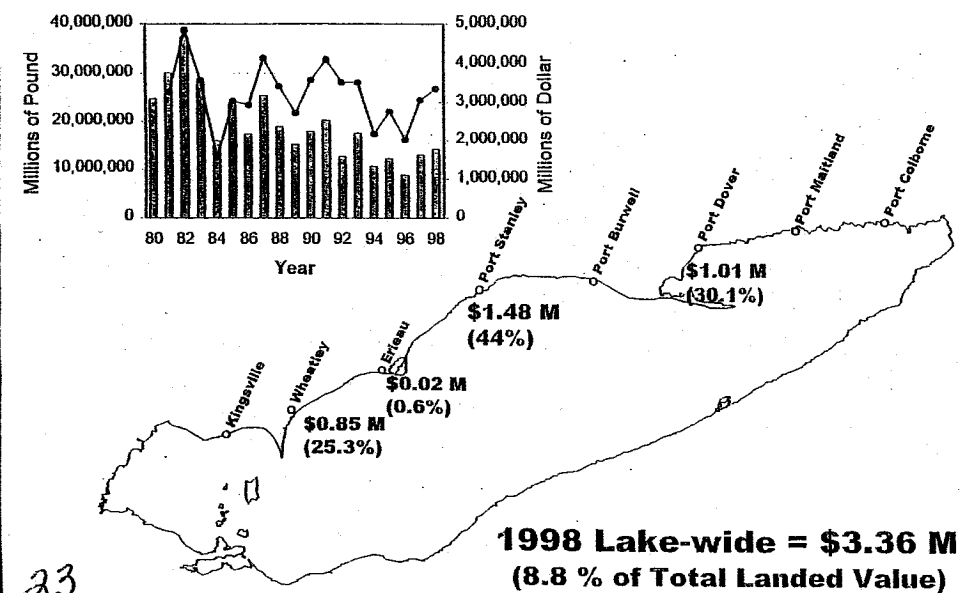
## Canadian Commerical Walleye Harvest Trend and 1998 Landed Value by Port



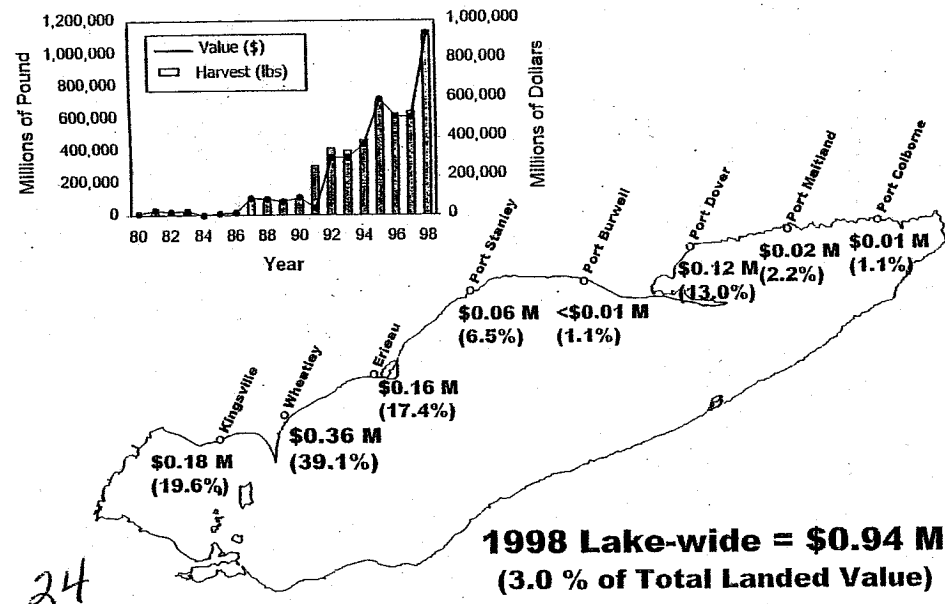
## Canadian Commerical Yellow Perch Harvest Trend and 1998 Landed Value by Port



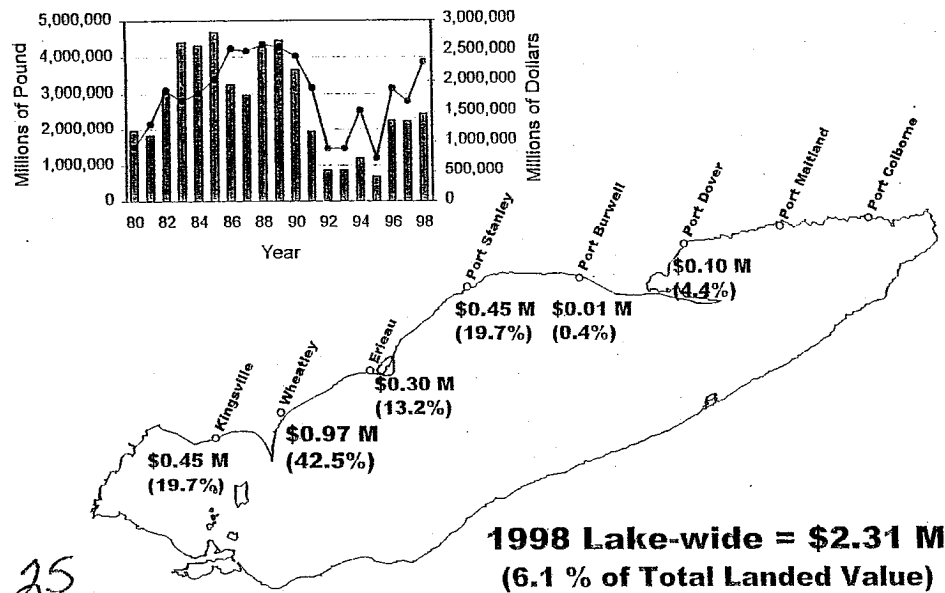
## Canadian Commerical Rainbow Smelt Harvest Trend and 1998 Landed Value by Port



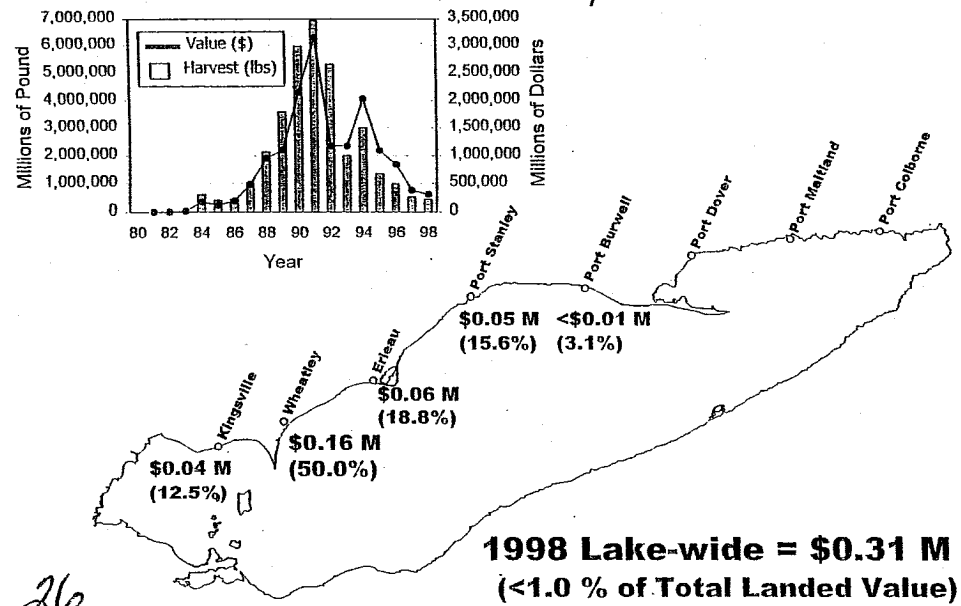
## Canadian Commerical Whitefish Harvest Trend and 1998 Landed Value by Port



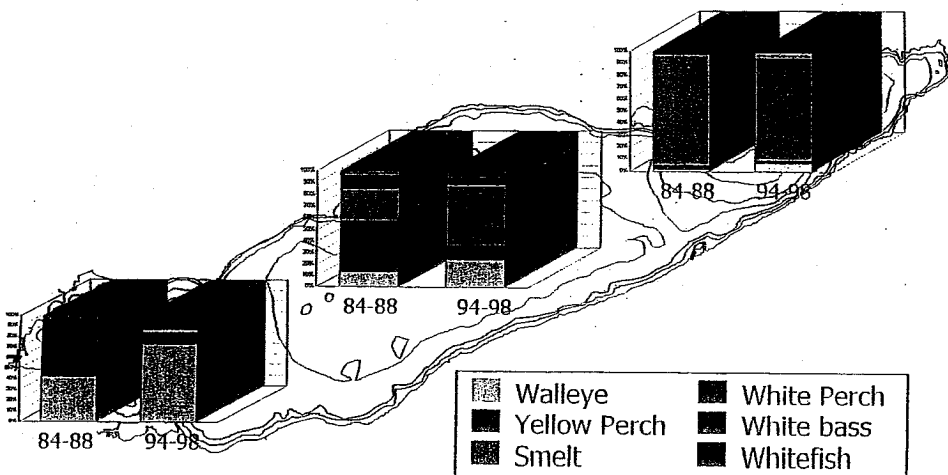
## Canadian Commerical White Bass Harvest Trend and 1998 Landed Value by Port



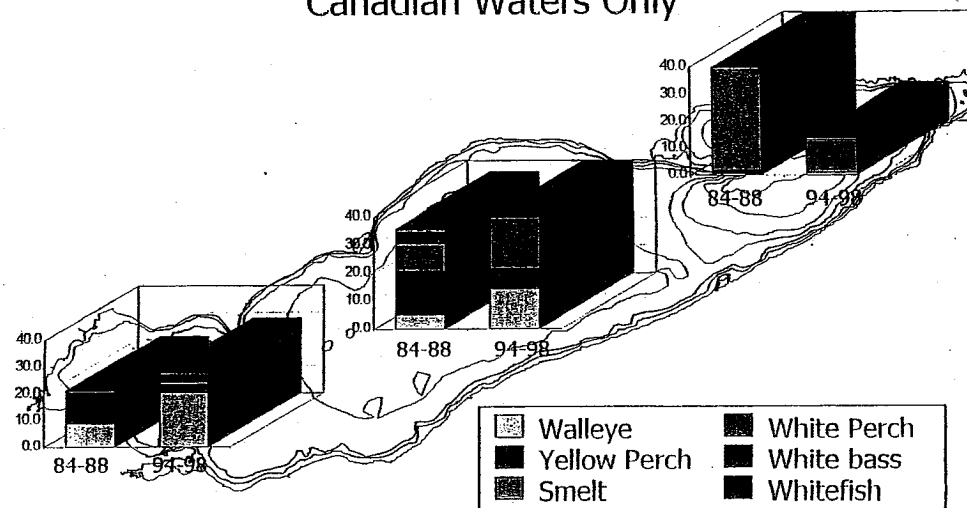
## Canadian Commerical White Perch Harvest Trend and 1998 Landed Value by Port



## Percent of Basin Harvest (lbs) by Species, 1984-88 (pre-zebra) and 1994-98 Averages Canadian Waters Only



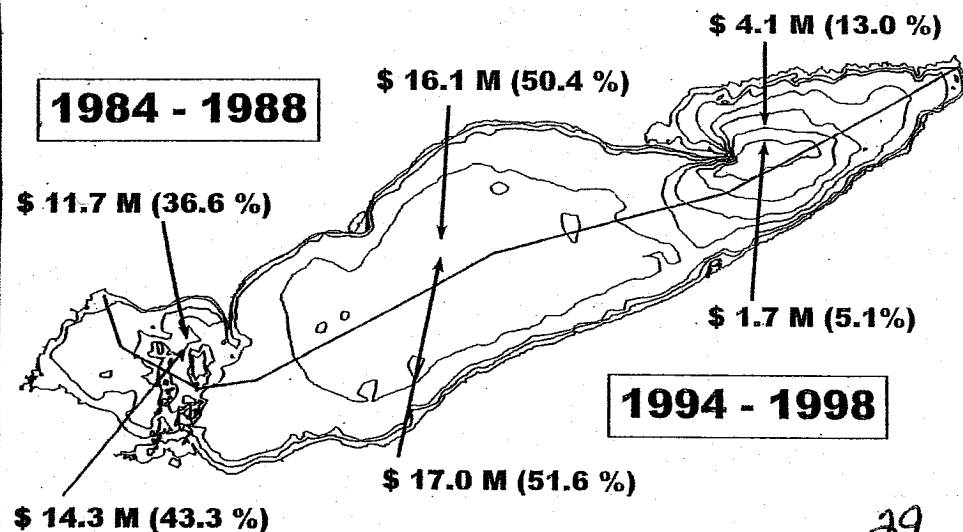
## Percent of Lake-wide Harvest (lbs) by Species and Basin, 1984-88 and 1994-98 Averages Canadian Waters Only



Total Average Landed Value of Commercial Fishery by  
Basin for the Periods of 1984-88 and 1994-98  
Canadian Waters Only

**1984 - 1988**

**1994 - 1998**



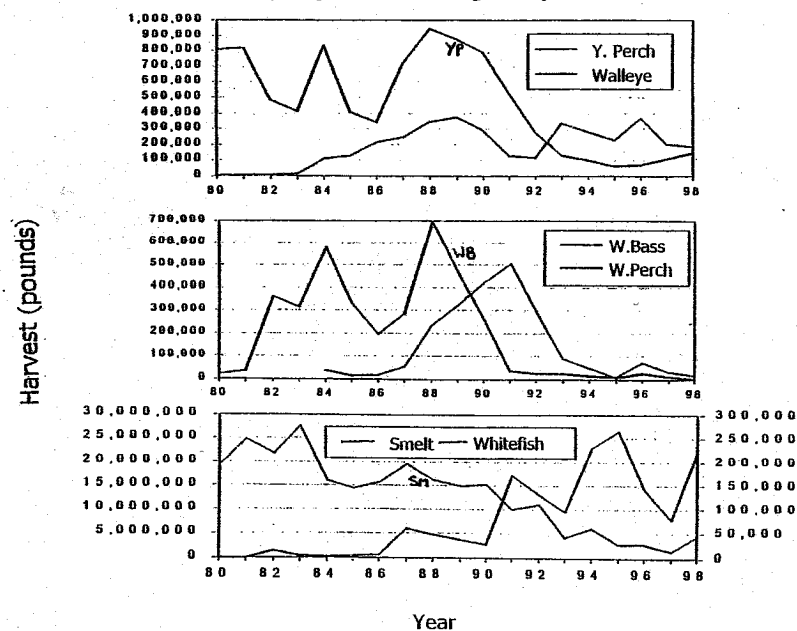
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Five Year Averages for the Lake-wide Commercial  
Landed Weight (lbs) by Species,  
Canadian Waters Only

Species	Pre-Zebra		% Change
	1984-88	1994-98	
Walleye	5,956,000	10,239,000	71.9
Yellow Perch	10,310,000	3,136,000	-69.6
Smelt	20,412,000	11,740,000	-42.5
Whitefish	45,800	717,000	1465.5
White Bass	3,891,000	1,773,000	-54.4
White Perch	938,000	1,270,000	35.4
Total Avg. Landing	41,554,000	28,876,000	-30.5
Total Avg. \$ Value	32.0 M	33.1 M	3.4

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Trend in Harvest (lbs) of the Major Species in the East Basin



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Five Year Averages for the East Basin Commercial  
Landed Weight (lbs) by Species,  
Canadian Waters Only

Species	Pre-Zebra		% Change
	1984-1988	1994-98	
Walleye	208,840	254,224	21.7
Yellow Perch	650,752	98,388	-84.9
Smelt	16,350,487	3,492,222	-78.6
Whitefish	23,439	186,770	696.8
White Bass	418,851	29,558	-92.9
White Perch	70,793	18,899	-73.3
Total Avg. Landing	17,723,161	4,080,062	-77.0
Total Avg. \$ Value	4.14 M	1.70 M	-58.8

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## INDUSTRY ISSUES AND CONCERNS



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## Industry Today

- Largest freshwater commercial fishery in the world
  - despite major and on-going changes in fish community and ecosystem

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## American Commercial Fishery

- Major gear restrictions and restrictions on the sale of some highly valued species have substantially reduced U.S. contribution to lakewide commercial harvest
- Commercial operations now restricted to live capture gear
- Approximately 38 active licenses in U.S. comprised of seine and trapnet fisheries
- 12 % of lakewide harvest (lbs) and 8.4% of landed value in 1998

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## Ontario Commercial Fishery

- Very important to provincial economy
  - particularly to local communities along the lake
- 38 million dollars landed value in 1998
  - 92% of walleye and yellow perch exported
  - 99% of rainbow smelt exported
  - generates new dollars for province
- Employs approximately 1800 people
- 213 active licenses:
  - 188 gill net and/or trawl (~80 vessels)
  - 25 live capture (seines, hoop nets and trap nets)
- Approximately 11 processing plants
- Expanded value of industry estimated by OCFA to approach \$400 million dollars

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## Canadian Commercial Industry Concerns

- **Rapid changes in fish community and ecosystem**
  - large investment in specific technologies
- **Major investments in Lake Erie percids**
  - harvest technologies, processing and marketing
- **Yellow perch and walleye make up 84% of total value**
  - 70% reduction in perch harvest since '80-84
- **Walleye harvests have increased by 72%**
  - reduced growth, abundance a big concern
- **Major investments in trawl fishery for smelt**
  - 42% reduction in harvest
- **Concern over effects of exotic species**
  - want regulations with teeth
- **Declining ability of management agencies to sustain longterm assessment programs**
  - implications to resource allocation decisions
  - particularly NB in rapidly changing ecosystem and fish community
- **Declining research capability at lower trophic levels**
- **Want fisheries management based on good science**
  - not on best guesses
- **Concerned that fisheries managers may be forced to take "easy way out" and simply follow the system**
  - fisheries vs water quality objectives
  - needs of all interests must be balanced

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## Industry Concerns (cont'd)

- Concerned that water quality agencies may not be considering fish community structure and production
  - need to ensure productive harvests of highly valued percids
- Concerned that agency efforts to introduce exotic salmonids and restore some native species may negatively influence commercial fishery
- Concerned over major declines and shifts in fish community in east basin
  - loss of large portion of Lake Erie as a major contributor to industry
  - major implications to economies of local communities of east basin
- Concerned that harvest estimates (principally sport fish) are not rigorous and question their accuracy
  - implications to commercial allocations and TACs
- Want effective controls and monitoring on all resource use (commercial, sport and baitfish extraction)
- Concerned over apparent declines in abundance, distribution and species composition of forage base

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## RESEARCH AND SCIENCE PRIORITIES

### Ecosystem and Fish Community

- Relationship of lower trophic levels and water quality parameters to fish production, fish community structure and composition
- Food-web dynamics and influence on key commercial species
- Improved fish community and ecosystem approaches to fisheries management
- Develop means of achieving FCGO's
- Improved understanding of ecosystem, fish community and stock dynamics
- Restoration of optimal ecosystem for percids
- Improved understanding and management of forage base based on strong science

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## Habitat

- Determine optimum habitat requirements for major commercial species (esp. percids)
- Develop and test methods to return optimal environmental conditions for percids
- Identification of critical habitats for key commercial fish species
  - implement strong habitat improvement and protection strategies

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## Restoration

- Restoration of native fish species
  - understand implications to production of highly valued commercial species
  - assess harvest potential
- Restoration of healthy, productive fisheries in east basin based on highly valued species
- Restore critical habitats for highly valued species
- Develop specific fish community and ecosystem approaches to rehabilitation and protection of key commercial species

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## Assessment and Harvest Management

- Improve methods of estimating abundance and safe harvest levels
  - based on ecosystem and fish community approach and strong science
- Determination of minimum stock sizes for spawning and recruitment success
- Development of management and harvest strategies based on stock dynamics
- Improved indicators and forecasting techniques
  - effects of environmental change on abundance indices
- Improved estimates of natural and fishing mortalities
- Factors affecting production, survival, mortality and recruitment of key commercial species
- Improved harvest estimates by all resource users
- Development and protection of longterm assessment and research programs at all trophic levels
  - aimed at ensuring longterm sustainable fisheries of highly valued species
  - based on sound scientific principles

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## Exotic Species

- Improved understanding of the effects of exotic species invasions on dynamics of key commercial fish species
- Improved biological, technological and management techniques to prevent/manage exotic species
- Identify optimum fish community resilient to exotic species invasions

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### Fish Stock Dynamics

- Identify discrete stocks of key commercial fish species and their present/potential importance to sustainable, productive fisheries
- Develop stock protection and enhancement strategies based on sound science
- Develop harvest management strategies with due regard for stock concept

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### COMMERCIAL FISHERY

#### Next 5 Years

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- Restoration of highly valued species in east basin fish community

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